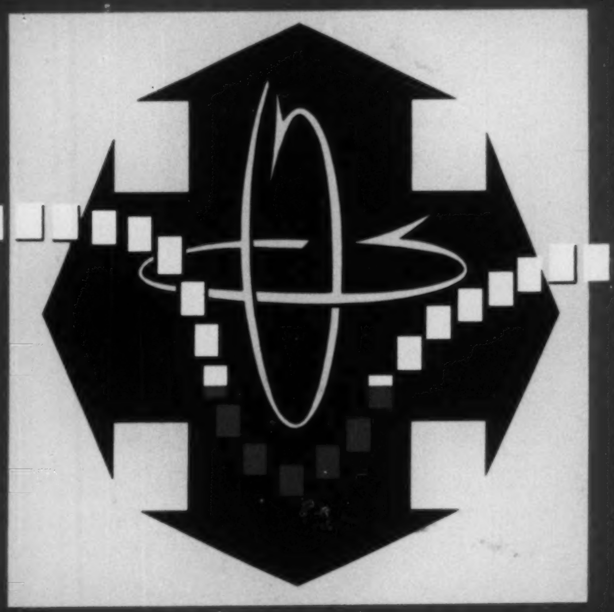
AUTOMATION

JANUARY 1958



AUTOMATED SYSTEMS USE

Integrated Handling

The Magazine of Automatic Operations

- ▶ Magnetic Handling Devices
- ▶ Handling Small Parts for Assembly
- ▶ Auxiliary Handling Devices
- ▶ Automatically Handling Parts in Process
- ▶ Pneumatic Handling Systems

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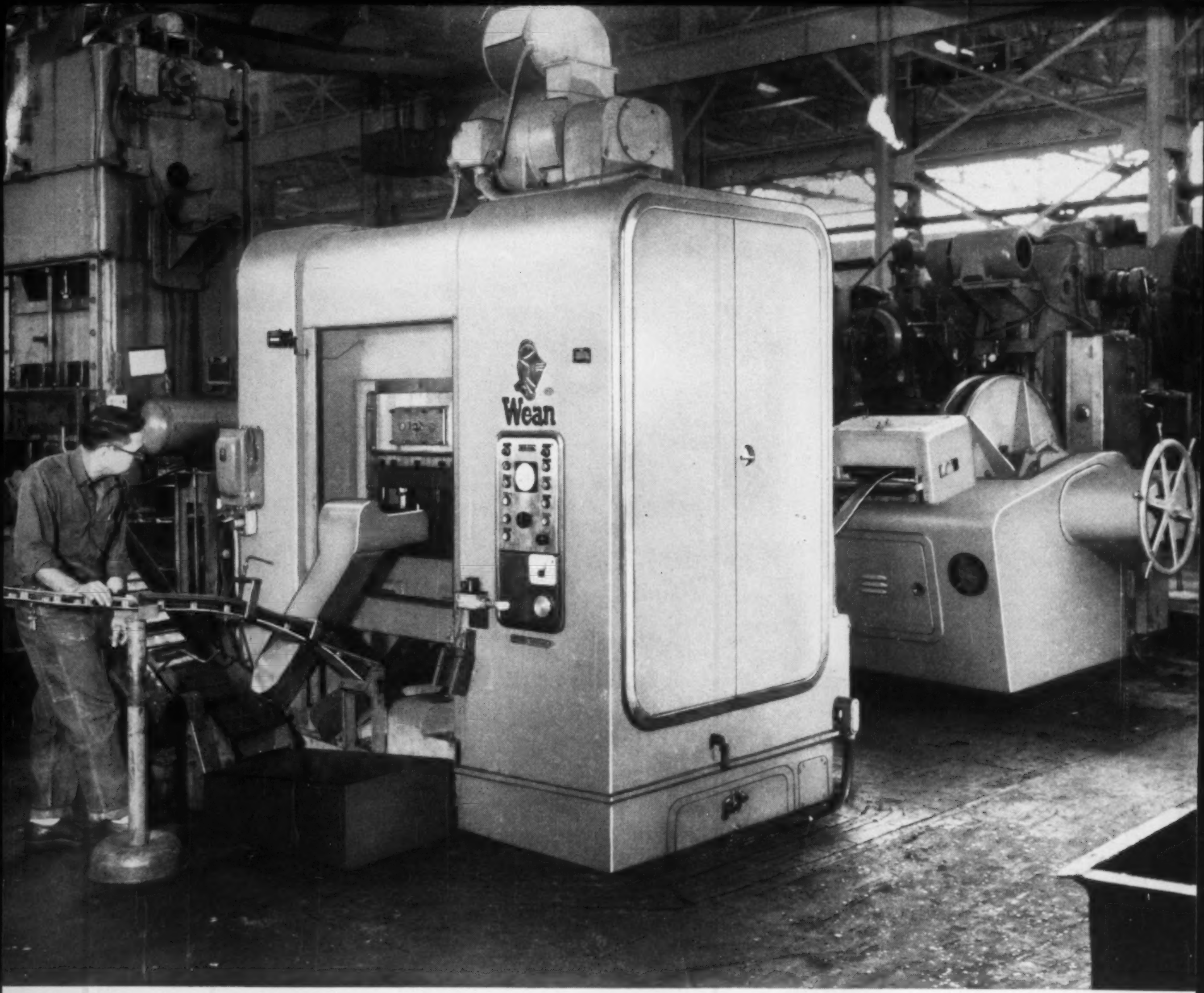
A PENTON PUBLICATION



One Wean "Flying Press"

replaces two conventional presses

475

THE 100 x 24 x 36 WEAN FLYING-PRESS, above, is turning out transmission vanes in the plant of a major automobile manufacturer. The vanes, 3¾″ long by 1⅝″ wide, are blanked out of .042″ steel strip and formed through a seven stage die. Previously produced by two conventional presses, each operating at 154 S.P.M., their combined production will be more than equaled by this single Wean Flying-Press operating at 350 S.P.M. Typical of the specialized engineering which Wean applies in "tailoring" press and auxiliary units to a specific operation is the ingenious mechanism which receives the vanes from the press and nest-stacks them for maximum ease of handling.

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In addition to increased production rates, the Flying-Press incorporates many other cost saving advantages, too. But get the complete story by writing today for your copy of the Wean Flying-Press brochure.

Wean Equipment Corporation

CLEVELAND 17, OHIO

Circle 651 on Page 17

Ross ✦ Skyline

Now-All the basic valves-*and more*- in this *long life* air valve series

WHITEMODEL SPOOL SOLENOID
WHITEMODEL SPOOL SOLENOID MOMENTARY
GOLDMODEL OIL-IMMERSED SOLENOID
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SILVERMODEL JIC SPOOL SOLENOID
SILVERMODEL JIC SPOOL SOLENOID MOMENTARY
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BLUEMODEL AIR-OPERATED
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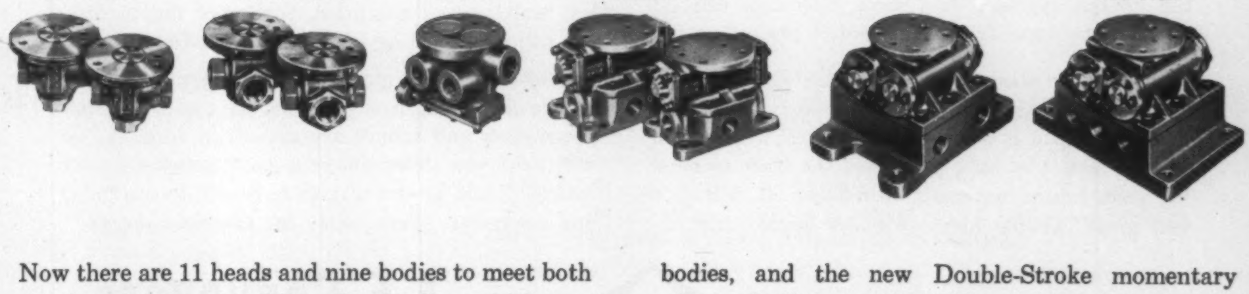
BLUEMODEL AIR-OPERATED TIMED-OUT

match any head to any valve body!


STRAIGHTWAY NORMALLY OPEN NORMALLY CLOSED
3 WAY NORMALLY OPEN NORMALLY CLOSED
4 WAY
3 WAY NORMALLY OPEN NORMALLY CLOSED
4 WAY
4 WAY 5 PORT

Now there are 11 heads and nine bodies to meet both usual and unique problems in the line which was designed to give you the longest life and greatest adaptability of any valve line in the world. All heads are readily interchangeable with all Skyline valve bodies, and the new Double-Stroke momentary adapter further multiplies the number of valve combinations. What is your problem? Drop us a note explaining it, or call your nearby Ross field service engineer for details on the Skyline valve to solve it.

Combining Engineering With Ingenuity for Better Air Control

Ross OPERATING VALVE COMPANY

131 EAST GOLDEN GATE AVENUE • DETROIT 3, MICHIGAN

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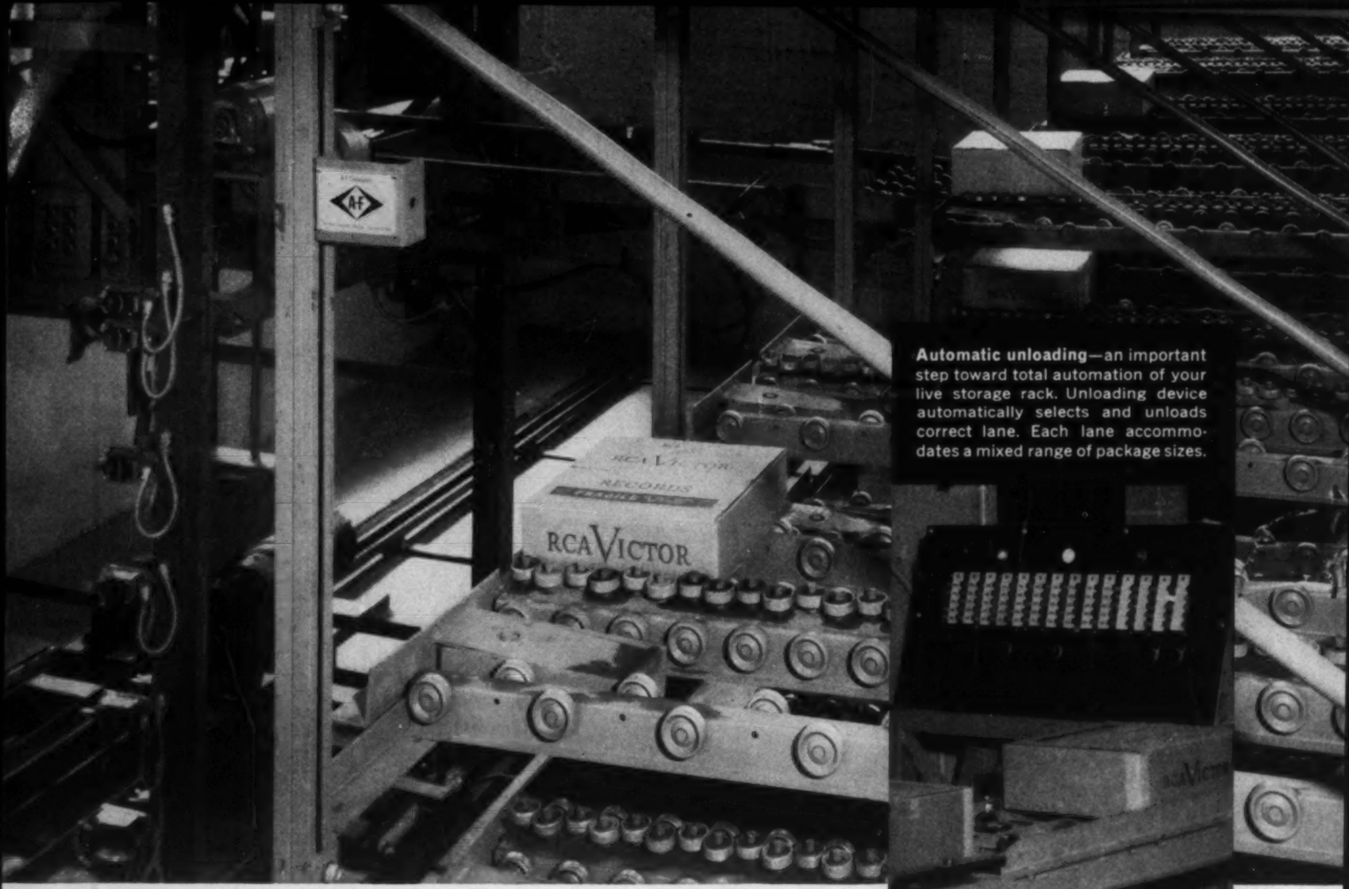

Automatic unloading—an important step toward total automation of your live storage rack. Unloading device automatically selects and unloads correct lane. Each lane accommodates a mixed range of package sizes.

Push buttons actuate removal from storage. Same operation can be accomplished by tape or card control, if desired.

A-F LIVE STORAGE RACKS

Totally automatic...or "push button"...or as much automation as you can profitably use

Your AF Live Storage Rack *can be* totally automatic—even to the point where packages actually dictate their own route and "find" their own storage—then unload themselves after a specified period of time, as needed. The rack shown is unloaded by push-button remote control. One man (or woman) removes items from storage without moving from the control console. This same operation can be actuated by tape or card control if desired.

Perhaps your plant is ready for this kind of automation—or perhaps it's still a few years away. The important point is that when you invest in your live storage rack, you have purchased the basic element for your future automatic warehouse. It will give you great benefits today—whether loaded and unloaded by hand, by lift truck, or by other mechanical devices. Then, at a later date, it can be converted—simply by adding automatic loading and/or unloading devices.

Whatever degree of automation you specify, the fundamental advantages of live storage will be yours from the outset—orderly storage, elimination of needless walking and confusion, fool-proof first-in first-out control, space saving and many other benefits.

Our engineers will gladly survey your present storage facilities, make suggestions on cost-saving improvements and submit a proposal. In addition, we will help you determine just how automatic your system should be—for maximum benefit to you today and tomorrow. Write today for complete details.

A-F

A-F Conveyors

Custom Engineered Conveyor Systems
Packaged Conveyors—Wheel, Roller, Belt, Trolley
Pan and Rack Washers
Metal Cleaning and Processing Equipment

A-F founded the package conveyor business in 1901

Circle 655 on Page 17

The Alvey-Ferguson Company, Dept. UE-1, Cincinnati 9, Ohio

JANUARY 1958
Vol. 5—No. 1

AUTOMATION®

The Magazine of Automatic Operations

A PENTON PUBLICATION

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automation outlook

INDUSTRY RESPONSIBILITY

". . . automation does not grow of itself. Meticulous care and feeding are necessary. We cannot expect to reap a harvest unless the seed is sown. Industry has a responsibility to understand and employ automation to the fullest practical extent if we are to realize our aims of increased living standards and job levels in the years to come. . ."—*Roger W. Bolz, editor,* AUTOMATION, *see page 141.*

INTERGROUP CO-ORDINATION VITAL

". . . when planning extensive automation lines, close co-ordination between designers and manufacturers of various components is absolutely necessary. Machine tool manufacturers and material handling manufacturers, as well as manufacturers of auxiliary equipment, like washers, dip machines, gaging instruments, etc., must co-operate to provide the best possible system. This is especially true where it involves transfer mechanisms within the machines that have to co-ordinate with transfer mechanisms between machines. This close co-ordination will prevent interferences, loss of cycle time and complicated mechanisms. It also assures most economical interlocking, smooth transfers, and the ability of the equipment to handle the required capacity . . ."—*Jervis C. Webb, president, Jervis B. Webb Co., see page 63.*

AUTOMATION NEED INCREASING

". . . the application of automatic devices to take over the stultifying jobs in our industrial plants and offices will mean the opening up of new vistas of economic accomplishment. As fewer workers will be needed to provide manufactured goods, more people will be able to provide for our spiritual and cultural requirements. There is one aspect to this problem that is seldom mentioned, yet may be the most important consideration. We can talk about increased production and higher standards of living and all that, but automation will accomplish something else. It will, for very selfish reasons, be a boon to management and labor alike, for it may some day be the only way of getting work done. Even now no one is left who wants to do the back-breaking jobs in factories. In 1850 muscle power performed 65 per cent of all work; in 1950, only 1½ per cent. In the first half of the present century the number of unskilled laborers dropped 15 per cent, but the number of engineers went up 1,000 per cent. It will become increasingly difficult to hire people to do routine and tedious work in offices too. They will demand more creative, more satisfying duties. Not only will automation not reduce job opportunities, it will be needed to make it possible for the labor supply to go around. By 1975, when automation is expected to reach its full impact on U. S. industry, it is conservatively estimated that there will be a demand for some 20 million more workers than are in the present-day labor force. This demand for more workers will result from the growth in population, with the increased consumption of goods and services. Population experts tell us that America in 1975 will be a nation of 220 million, 55 million more than today. But the number of workers (people in the age bracket 24 to 60) will not increase by the same ratio. This means, percentagewise, fewer people will have to produce more, at a time when pressures will be exerted to reduce the work week and possibly the work day. Managements, therefore, will be grateful to automation as the one way open to them for increasing productivity . . ."—*Wilbert E. Scheer, personnel director, Blue Cross and Blue Shield, Chicago, Ill.*

AUTOMATION

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BPA NBP

Circle 656 on Page 17→

Feeling "profit pinch"?

Talk to

Snyder

TOOL AND ENGINEERING COMPANY
3400 E. Lafayette, Detroit 7, Michigan

Special Machine Tools with Automation for More Than 30 Years

3 WAYS YOU CAN KEEP

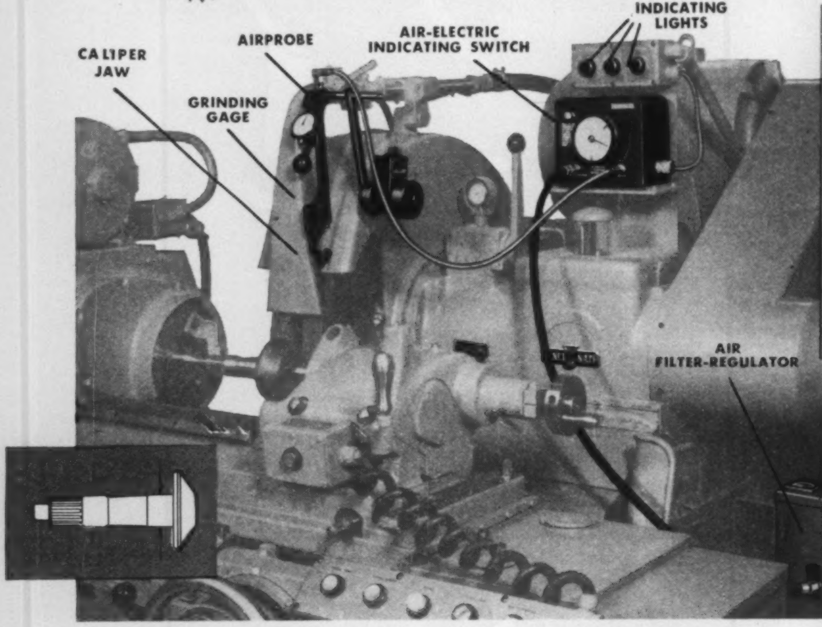
A BETTER PRODUCT . . . AT LESS COST . . . THROUGH ADVANCED GAGING . . . . . .

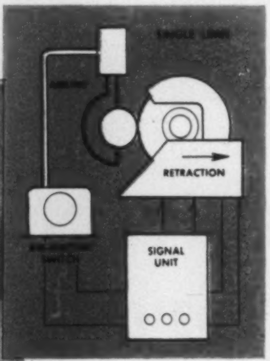
Profit margins aren't getting any better . . . just the opposite. With buying appetites fairly well satisfied, it's no longer a matter of "getting the stuff out". The problem now is making it *better at lower cost.* You certainly don't plan to let competition catch up to you. So consider these ways of improving product quality and, at the same time, cutting down on the cost per piece. Advanced gaging — by FEDERAL — can do it. The gaging ideas are proven profit makers. The gages, far from being monsters of automation, are compact, standardized units, realistically designed to provide automatic control or inspection, or both, where it does the most good and at a price that practically *every* manufacturer can afford. And they have reliability . . . the most important single feature of FEDERAL Gaging.

Whether you're big or small in terms of production, **at least one of these gaging arrangements can pay off for you.** *It's the truth. Ask us to prove it. Write:*

FEDERAL PRODUCTS CORPORATION
8391 Eddy Street, Providence 1, R. I.

1 AUTOMATIC CONTROL OF FINISH SIZE





This standardized control gage continuously measures and indicates size of work as it is being ground and automatically causes wheel to retract the instant finish size is reached. Unit can be easily applied in the field to any center type grinder having hydraulically controlled wheel slide. Quick delivery because all gage components are stocked.

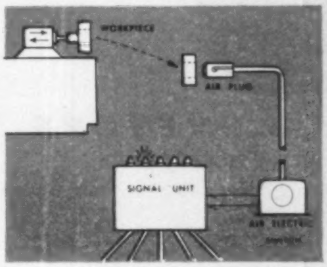
BENEFITS: *Reduces cost of operation — permits one operator to handle two, possibly three grinders performing the same or different operations. In this way gages pay for themselves within a few months.*

Improves quality — even if you have only one grinder, gage is a profit-maker because it eliminates error due to operator inattention or fatigue and also eliminates cost of later inspection. Gage never tires, is accurate to .0001" or better, is easily adjustable to control different sizes of work. Its Air-Electric system overlooks minor workpiece surface irregularities which confuse size readings of other gages.

VARIATIONS: *Similar FEDERAL Gages are available through machine tool manufacturers to also change wheel feed rate to dwell grind . . . or to control dressing cycle and finish size on I.D. grinders. When specifying machine tool requirements be sure to include* FEDERAL *Gaging.* FEDERAL *maintains close engineering alliance with all leading machine tool manufacturers.*

AHEAD OF COMPETITION

2 AUTOMATIC 100% INSPECTION

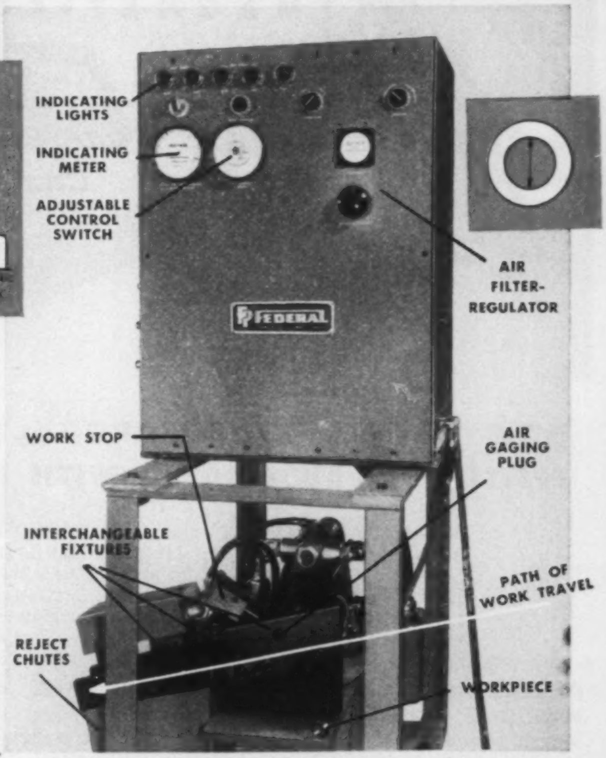

WORKPIECE
AIR PLUG
SIGNAL UNIT
AIR ELECTRIC SWITCH

This standardized "post-process" gage inspects every part as it is discharged from the machine and sorts work into "good", "near-over", "near-under" plus "salvage" and "scrap", indicating the size of each piece as it is gaged. Operator, watching large indicating lights, can compensate machine for drift and piece-to-piece variation *before any scrap parts are produced.* Unit can be applied to any type I.D. or O.D. grinder, lathe, boring machine or screw machine. Gaging fixtures can be made interchangeable to handle various work sizes.

BENEFITS: *Lower cost per part. Gage virtually eliminates scrap by showing trend before tolerance limits are reached.*

Eliminates inspection errors — gage has 99.8% reliability or better as compared to about 92% for operator inspection and about 85% for inspection by other personnel.

VARIATIONS: FEDERAL *Gages of similar type are available through machine tool manufacturers to also provide automatic compensation of the machine, either proportionally or by increments, so that drift is corrected without need for operator attention. Moral: To get the maximum return for your investment, be sure to specify* FEDERAL *Gaging when you're buying machine tools.*


INDICATING LIGHTS
INDICATING METER
ADJUSTABLE CONTROL SWITCH
AIR FILTER-REGULATOR
FEDERAL
WORK STOP
AIR GAGING PLUG
INTERCHANGEABLE FIXTURES
PATH OF WORK TRAVEL
REJECT CHUTES
WORKPIECE

INDICATING LIGHTS
INTERCHANGEABLE GAGING FIXTURES
FEDERAL
SQUARENESS
WORKPIECE
INDICATOR/SWITCHES (ELECTRICATORS)
3 OF 64 WORKPIECE SIZES FOR WHICH GAGE IS ADJUSTABLE

3 SEMI-AUTOMATIC, MULTIPLE DIMENSION MEASUREMENT

Ideal for small and medium production manufacturers, this gage checks nine dimensions in two stations and is adjustable for 64 different sizes! Work is loaded and disposed of manually. Lights show "good", "over" and "under". Units like this one have paid for themselves in well under six months.

BENEFITS: *Reduces non-productive costs — inspection time per part, in a typical case, is reduced 75%.*

Improves quality level. Inspection error is eliminated. Greatly reduced time permits profitable 100% inspection instead of sampling.

Reduces labor cost. Inspection can be performed satisfactorily by less skilled personnel.

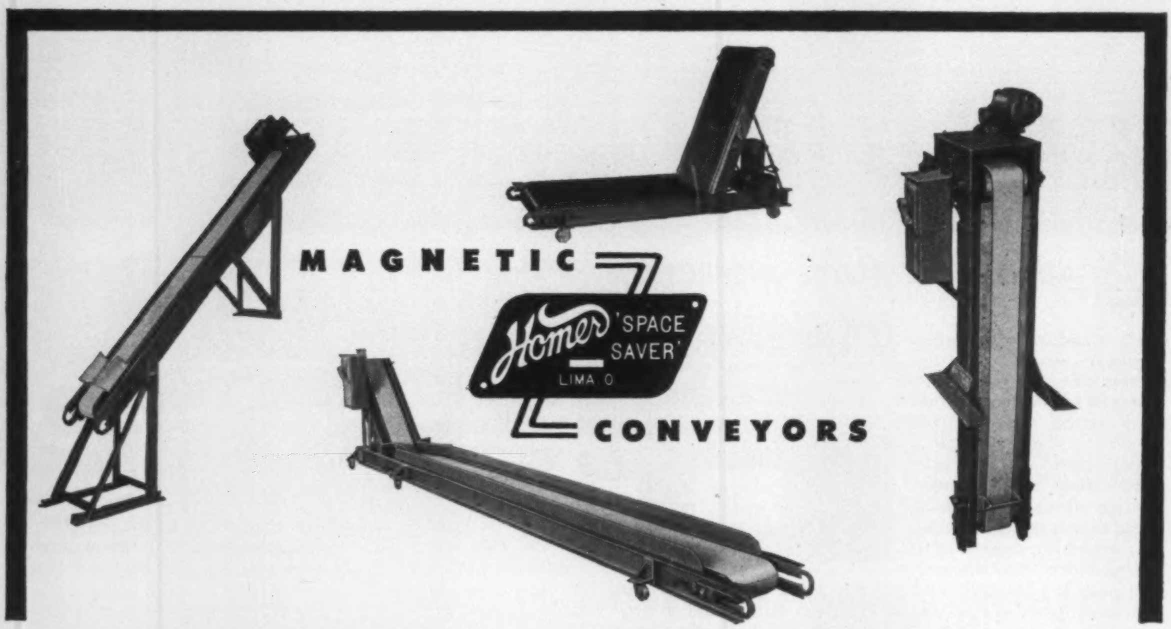
VARIATIONS: *Unit can be designed to provide virtually any combination of dimensional measurements. Sensing elements, electrical components, housing and base are standardized. Other components designed to suit. Unit can incorporate semi-automatic disposal. Number of other design possibilities all the way up to a completely automated inspection and control gage. In every design the emphasis is on reliability. That's why, when you buy* FEDERAL *Gaging, you buy results.*

Ask **FEDERAL** *First*

FOR RECOMMENDATIONS IN MODERN GAGES . . .

Dial Indicating, Air, Electric, or Electronic — for Inspecting, Measuring, Sorting, or Automation Gaging

Circle 657 on Page 17



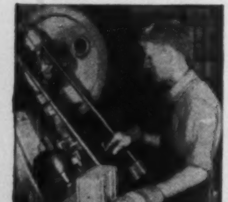
HOW MUCH OF YOUR PRODUCTION COULD BE MORE EFFICIENTLY AUTOMATED WITH HOMER MAGNETIC CONVEYORS?

Shown are four of many specially designed Homer Magnetic Conveyors that are serving some of the nation's largest manufacturers. Every metalworking plant handling ferrous parts and pieces has many operations where features of Homer "Space-Saver" Magnetic Conveyors will increase automation and lower costs. Check your production for potential applications . . . Then write for Homer's recommendations. Homer Magnetic Conveyors available in 85 standard sizes . . . plus special models for solving unusual problems.

INCREASE PRODUCTION SPEEDS AND AUTOMATIC HANDLING. Optimum magnetic strength per unit length permits faster belt speeds (up to 250 fpm) at steeper angles (up to 90°)—depending on job application and recommendation. Prevents damage to critical finishes caused by contact between parts or jamming in flapper gates . . . Ends slipping and loss of parts because of steep inclines, belt resiliency or bouncing over belt cleats.

CONVEY UP STEEP INCLINES WITHOUT BELT CLEATS. The "Space-Saver" uses standard stock belt . . . requires no cleats or buckets, even when conveying parts up 90° incline.

ADJUSTABLE MAGNETIC PULLEY ASSEMBLY. For product control, head pulley contains an adjustable, permanently magnetized assembly (Patent Pending) which eliminates the need for nosed-over delivery section.



HOMER PERMANENT MAGNETIC SHEET SEPARATORS

Automatically separate stacks of oily, polished, enameled or painted sheets without prying, scratching or marring the surfaces . . . Speeds handling of round, square, irregular or nested steel shapes in shearing, pressing or other production operations. Write for Bulletin SS-210.

SOLVE UNUSUAL HANDLING PROBLEMS. Can be supplied to convey horizontally or vertically or in combination of horizontal and vertical . . . to convey on top and underside of conveyor for parts turn-over applications . . . to handle multi-story conveying . . . to convey up or down at angles up to 90° . . . or for many other unusual applications.

VERSATILITY IN LOADING. Can be supplied with magnetically energized tail pulley to pick up pieces from floor . . . or Homer Magnetic Conveyors can be loaded from any angle at any height above floor. Does not require hopper or side boards in many applications (available if required).

EFFICIENT, TROUBLE-FREE DRIVE. Positive chain drive with choice of gearhead or separate motor and speed reducer. Drive mountings designed for maximum safety.

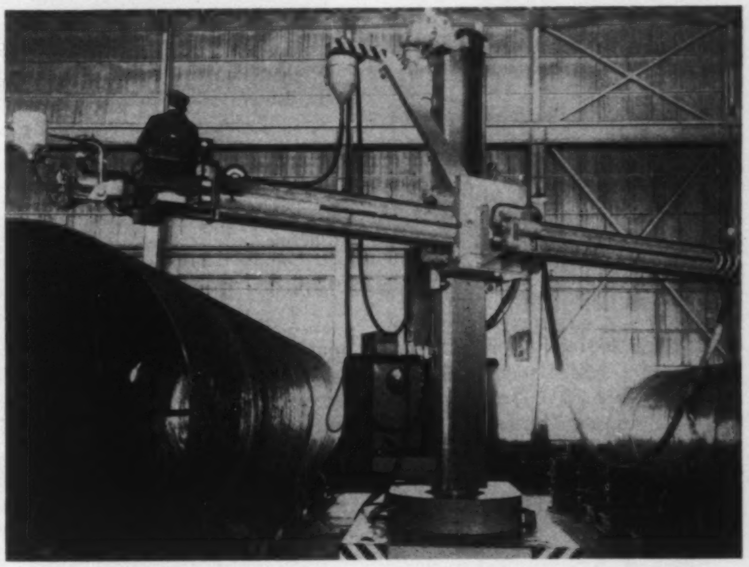
The Homer Manufacturing Division backs its magnetic conveying recommendations . . . to your satisfaction. Bulletin MC-250 describes and illustrates Homer "Space-Saver" Magnetic Conveyors. Write for it today.

HOMER MANUFACTURING DIVISION
The Ohio Electric Mfg. Co.
Dept. 286 Lima, Ohio

HOMER —FIRST IN PERMANENT MAGNETIC EQUIPMENT FOR INDUSTRY!

AUTOMATION news

Today's events and developments in the field of automation



HIGH SPEED automated welding of pressure vessel shells at Davie Shipbuilding Co., Quebec, Canada, is accomplished by using an automatic, pushbutton controlled welding head manipulator manufactured by Pandjiris Weldment Co. The operator rides the manipulator while the steel shell at the left is welded and rotated beneath him. When this shell is completed, he rotates the welding station 180 degrees to second vessel on the right. While second shell is being welded, the first shell is removed and the next vessel to be welded is set up on the rollers. Economical, high speed automatic welding is accomplished by being able to change welding positions quickly and by keeping welding equipment in operation for the maximum length of time.

1957 In Retrospect—Automation Grows In Stature

By ROGER W. BOLZ, Editor

AUTOMATION made noteworthy progress in 1957 and greater technological innovations in this field are on the horizon for 1958. Industries throughout the country, both large and small, were able to point with pride to ever increasing use of automation concepts. Even organizations such as banks, department stores, bakeries, airlines, hotels, etc., were able to say that they had adopted and put into practice various aspects of automation during 1957.

Acceptance of the concept of automation in 1957 can be judged by its appearance at high level discussions. An agency of the United Nations, The International Labor Organization, produced a report on the social implications of automation and technological developments. The report stated that industrial disturbances and social unrest are not necessary consequences of technological changeovers. Automation and other developments make it possible to produce many things that could not have been produced or done before. Thus, representatives of 77 member nations of the United Nations recognized the impact of automation, and established it as a world wide concept.

Interest of the United States government in automation was expressed by **Representative Wright Patman** (Texas), chairman of the Joint Economic Committee of the Congress, at the second annual Automation Conference sponsored by Purdue University and AUTOMATION magazine. He stated: "The fact that Congress continues to be interested in automation and will doubtless hold more or less periodic hearings on the subject must not be misunderstood. The government's interest in automation is primarily that of making certain that the individual, human costs of widespread material progress are kept at a minimum. We want to be sure that the private enterprise system upon which we rely is functioning smoothly today and is not building up pressures or frictions that may mean trouble in the future."

Throughout industry the common basic approaches to utilization of production equipment for automated systems could be categorized as: Using standard equipment integrated into a continuous line; applying building block techniques to develop special-purpose machines and lines; solving the production problem with transfer-type equipment; developing entirely special - purpose production equipment where conditions so demand. In 1957 another approach became common enough to receive wide notice. Numerical control of machine tools was taken out of the realm of theory and became another "tool" in the continuing trend toward more automatic machine tools. In 1957 the technique was extended to machines for smaller runs and job lots and no less than 350 companies were recorded as developing items for use in such equipment.

Punch card control of some steel mill screw-down operations saw regular production use in 1957. Release of operators from strenuous work and the new accuracies achieved along with flexibility and better productivity foretell wider application of these principles in heavy, time-consuming mill operations.

Integrated handling made many gains in 1957. In addition to aiding the integration of production lines, conveyors were utilized for storage and automatic handling throughout entire plants. In one glass container plant, manufacturing and shipping operations were linked by a complex system of more than 200 conveyors, 12 control centers, and 400 photoelectric devices. Over 180,000 cartons per day of 27 different sizes are transported from manufacturing areas to shipping or warehouse facilities on the conveyor system. When we consider the costs of moving parts through a long series of operations, it becomes clear that here is a fertile field for automation development in the reduction of production costs. It was recently estimated in one large electrical manufacturing plant that handling is responsible for about 25 per cent of the total cost of the product and for about 40 per cent of the total labor cost.

Process control automation grew in importance to industry. Many experts agree that in the next ten years larger and larger expenditures will be made by industry for automatic control of manufacturing. Appearance on the market of small, dependable computers that are designed for specific adoption to automatic process control make this type of automation possible. Automation is also advancing through the application of fast, flexible, and precise gaging systems. In the field of machine tools, refinements leading to more automatic machines have been matched by ingenious developments in gaging equipment—developments permitting the use of gaging systems to control machine functions.

NATIONWIDE integrated data processing system linking 18 control cities has been started by Western Union Telegraph Co. Control cities accumulate and convert to five-channel, common-language, perforated tape information on payroll, inventory and other statistical data from Western Union offices throughout the country. The tape is telegraphed to one of five IDP centers in New York, Atlanta, Chicago, Dallas, or San Francisco. As the tape information arrives by wire at a typical center, shown above, it is automatically converted to punched cards which are later processed through business machines for translation into payroll checks, inventory records, and other management information.

Automation also made outstanding progress outside of industry. Major equipment manufacturers announced plans for automating check handling in banks and the next several years should see complete systems of equipment available. Data processing systems have been installed in some department stores, and service has been speeded with the elimination of hand written sales books. More airlines have installed data processing systems for controlling advance seat reservations. Some bakeries have installed automatic unloading facilities for hot rolls and buns direct from baking ovens.

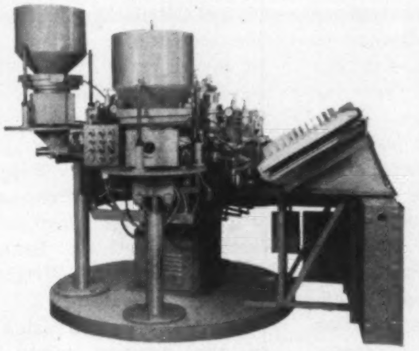
What is the status of automation in Europe today as compared to that in America? **Harold E. Collins,** president of American Society of Tool Engineers, recently stated: "Naturally, automation has not progressed as fast in Europe as it has in this country for the simple reason that a good supply of good craftsmen is available. Also, labor is considerably cheaper . . . this does not leave much room for developing automation as an economic measure . . . differential in labor rates (between Europe and America) will not supply the incentive for development of automation to the extent that is present in the United States. As the supply of skilled labor decreases and labor rates increase, the economic incentive to remove drudgery and repetitive tasks from industry is increased—providing a natural trend toward automation."

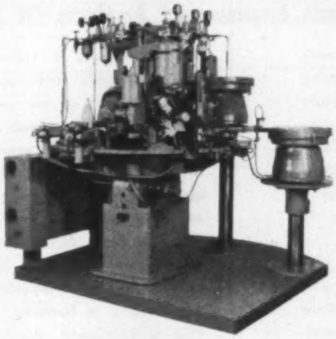
The year 1957 has been a notable one for automation. With a strong economy we can look forward to greater gains in 1958. Development of new equipment, new processes, new techniques, and new products will go hand-in-hand with the trend to more and better automation.

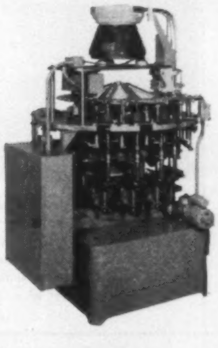
Conveyor Hauls Record Tonnage

SPEED record for materials handling has been set at Little Valley, Utah, where a 2-mile conveyor system, designed and manufactured by Hewitt-Robins Inc., is moving 30 million tons of gravel to build a 13-mile roadbed across Great Salt Lake for the Southern Pacific railroad. Although the conveyor system was designed to move material at an average rate of 75,000 tons a day, it actually aver-

Practically Speaking . . .







—who has all the answers on automation equipment?

We don't. BUT—

We had twenty years of specialized experience in designing and building automatic processing and assembling machines *before* the word was ever coined.

In designing and developing good automatic machines, there is no substitute for experience and you can have the benefit of ours without extra cost or obligation.

Whether it's for complete machines or one of our 200 tested and proven Standard Indexing Machine Chassis ready for application to your own designs, you owe it to your company to investigate.

SWANSON-ERIE
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AUTOMATIC ASSEMBLING AND PROCESSING MACHINES

aged 83,333 tons a day during a recent 30-day period. According to engineers of Morrison-Knudsen Co., prime contractor in charge of the earth moving project, this is the greatest average tonnage ever handled on any construction project.

The conveyor belts run at a speed of 850 fpm. The main-line belts are 54 inches wide and carry surge loads as high as 5,000 tons per hour. The unique conveyor system was put in operation in January, 1956, and has been running around the clock ever since except for temporary shutdown for maintenance.

Load Cells Speed Weighing of Hot Metal

WEIGHING of hot metal charges for open hearth furnaces has been simplified at Sheffield Div. of Armco Steel Corp., by using four load cells in place of a conventional beam and lever scale. The system was built by Electronics & Instrumentation Div. of Baldwin-Lima-Hamilton Corp.

The system uses four load cells rated at 100,000 pounds each to weigh loads of about 50,000 pounds. The cells support an I-beam platform on which the pouring ladle rests. Pouring of the hot charge is controlled by an operator in a booth beside the weighing platform. By watching an instrument connected to the load cells, the operator sees the exact weight of hot metal in the ladle at any point in the pour.

Hot metal spills frequently destroyed the weigh beams of the old type scales. Substitution of load cells has reduced damage to the weighing equipment and has lowered the cost and time required to repair damage. Since the cells are mounted on pedestals above the pit floor, hot metal spills that fill the pit to the pedestal height are unlikely. Splatter from spilled metal is shielded by metal housings around the cells.

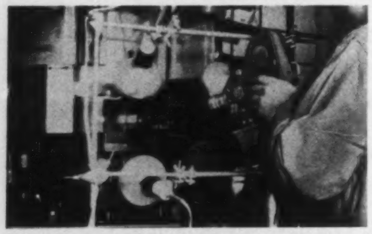
When the cells are properly calibrated, their hazardous location has no effect on their accuracy. Readings are transmitted by electrical impulses through cables to the instrument in the control booth. The cell system is not subject to errors caused by mechanical wear or by incrustations of dirt, lubricants, and other foreign matter. Weighing with the system is instantaneous, continuous, and accurate. The load cell system gives an initial weight with an accuracy of plus 0.25 per cent and can repeat weights to an accuracy of plus 0.10 per cent.

Titanium Extrusions Save Material And Reduce Cost

DEVELOPMENT of new production methods to extrude titanium jet engine parts directly from cast ingots has reduced the costs of finished parts as much as 40 per cent, according to a joint announcement made by Wright Aeronautical & Metals Processing Div. of Curtiss-Wright Corp. and Manufacturing Methods Branch, Air Materiel Command, Wright Patterson Air Force Base.

Utilizing the extrusion process as the primary metal working

Film Processor Speeds Engineering Analysis Of Jobs

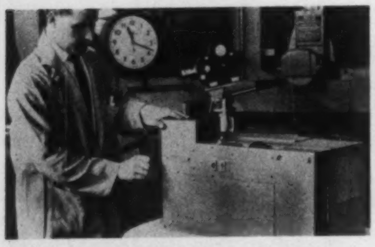


11:15 a.m.—Engineer is ready to analyze a punch press operation photographically. During next several minutes the high speed camera will record shock, shear, and tear characteristics of a new titanium alloy.

AVAILABILITY of the first automatic self-feeding, rapid film processing device for 16mm black and white film has been announced by Industrial Camera Div. of Fairchild Camera & Instrument Corp. The portable unit is capable of developing and drying film at a rate up to 10 fpm.

Inside the tiny processor are four interchangeable plastic film transport trays containing developing solutions consisting of a high speed developer, a rapid fixer, a hypo eliminating agent, and a static rinse. The film is speedily dried by blowing a heated air jet on the emulsion side.

Operation of the unit begins with the placement of exposed 16mm film in the film compartment. Two inches of the film are inserted into an entry port and the compartment closed. The film automatically threads itself through the processor to the take-up compartment. Within 20 minutes a hundred foot roll of film is developed, dried, and ready for projection.



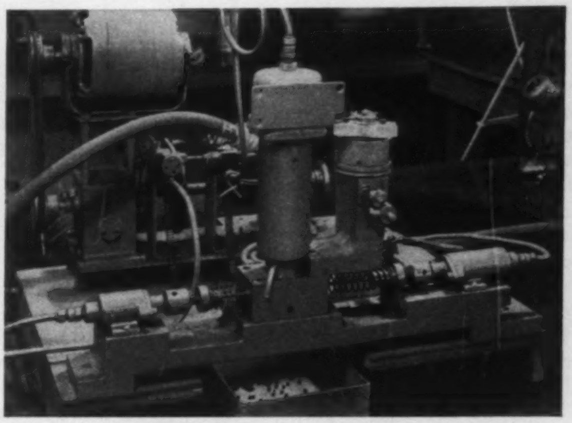
11:18 a.m.—Engineer feeds first two inches of film into a slot and drops film spool into feeding compartment of Fairchild film processor. Film automatically feeds through chemical baths, past drier, and to take-up spool.

11:34 a.m.—Developed 100 feet roll of film is ready for projection. When first few feet were developed, engineer examined it for proper development and made adjustments to compensate for exposure or chemical temperature variances.

11:38 a.m.—Film is projected on screen only 23 minutes after shooting picture. Engineer can immediately analyse slow-motion pictures of punch press operation and make any corrections necessary for tooling or material.

***Progress** in designing air systems:*

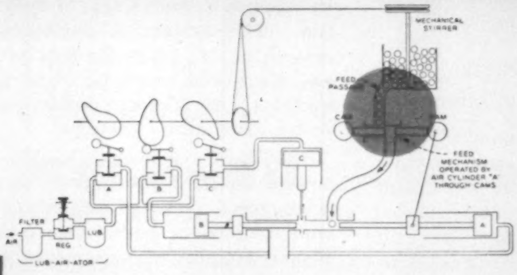
Here's another automating idea: Schrader Air Products in a multi-step punching system



Schrader Products successfully performing at prominent Western plant—feeding, shot-piercing, ejecting—all automatically with air.

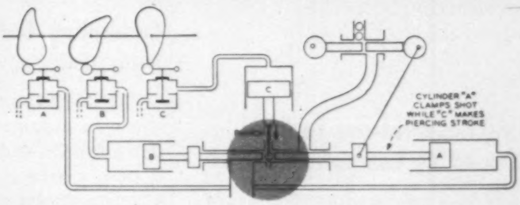
PROBLEM: To pierce tiny balls of lead shot, fast, accurately, and economically.

SOLUTION: Schrader Air Products designed into a system for automatic operation.


MECHANICAL STIRRER
FEED PASSAGE
CAM
CAM
FEED MECHANISM OPERATED BY AIR CYLINDER "A" THROUGH CAMS
A
B
C
C
B
A
FILTER
AIR
REG
LUB
LUB-AIR-ATOR

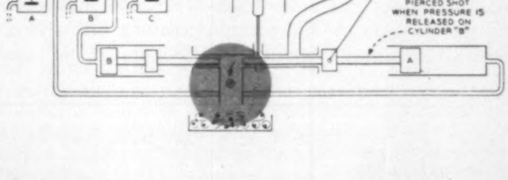
1

FEED: Performance of the cylinders in this system is controlled by cam-actuated Schrader valves. Cylinder A controls split-cam feed; allows the shot to be fed into the machine one at a time.


A
B
C
C
B
A
CYLINDER "A" CLAMPS SHOT WHILE "C" MAKES PIERCING STROKE

2

PIERCE: The shot is pushed forward and clamped at the piercing station by cylinder A and cylinder B. Cylinder C pierces the shot.


A
B
C
C
B
A
CYLINDER "A" EJECTS PIERCED SHOT WHEN PRESSURE IS RELEASED ON CYLINDER "B"

3

EJECT: Cylinder B returns to its initial position. Cylinder A completes its forward stroke, ejecting the pierced shot. And cycle starts again.

Air's benefits apply in almost any operation you can name: stamping, forming, programming, squeezing or measuring. And the advantages are more important today than ever: speed, accuracy, safety, simplicity, versatility, and—amazing economy. Schrader components are a natural for the designer because they comprise the only complete line of air products to select from. They can be used singly or in combination to perform jobs of amazing variety and complexity. When you design, think of air, and make use of Schrader's engineering facilities to help you specify the right products for your idea. Mail the coupon today.

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Circle 660 on Page 17

operation replacing forging and press equipment, cast ingots of titanium were used to manufacture various engine parts. By extruding directly from a cast ingot, both the cost of the forging operation and the material lost in forging are eliminated. Additional cost reductions are realized since less raw material is required and since the cost of cast ingots is approximately half the cost of forged billets.

The Curtiss-Wright process will have wide application, and will help place titanium on a more competitive level with other metals. The new process is not only applicable to titanium, but to other expensive metals where scrap losses seriously affect the finished product costs.

Airline Reservations To Be Processed By Computer

FIRST two production models of the IBM 305 RAMAC, a new electronic computer and accounting machine developed and manufactured by International Business Machines Corp., will be installed at the Denver operational headquarters of United Air Lines. The two electronic systems will be leased by United to speed the processing of thousands of ticket reservations made daily by the airline's many ticket offices across the country.

Heart of the RAMAC (Random Access Method of Accounting and Control) is a memory file consisting of 50 iron-oxide coated disks revolving at 1200 rpm. The file has a total capacity of 5 million characters of information. Information can be read from or written on the file in random sequence in a fraction of a second. The machine represents a new approach to machine accounting in that each business transaction is handled as it occurs and all related records are updated in the same processing step.

United Air Lines will utilize the two computers to keep a continuous check on advance reservations so that the "space available" status of a flight can be determined at any given moment. Leased telephone lines will be used to feed information to the machine on such matters as the number of passengers boarding at each stop, the number of passengers traveling from each boarding point to each destination, and the number of seats sold on each leg of the flight.

RECENTLY elected president of Electro Precision Corp. is **John Hosemann.** The new company specializes in industrial control systems. In addition to standard products, Electro Precision offers complete engineering and fabrication facilities to handle industrial control problems involving special purpose computer, servomechanisms, and magnetic recording techniques.

Computing Galvanometer Adds, Subtracts, Multiplies

COMPUTING galvanometer which will add, subtract, and multiply two signals and record the result is now available from Consolidated Electrodynamics Corp. The unit is designed for measuring low-level power in electronic equipment. It is ideal for recording instantaneous watts, and its phase sensitivity enables the user to determine power factor.

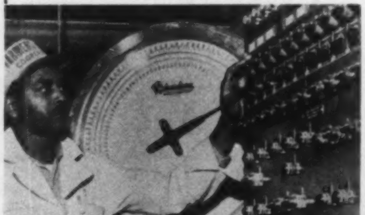
Three galvanometer bodies are used in the construction of the unit. A center body houses the moving-coil suspension and mirror, and two outside bodies house stationary field coils. A static reference mirror is fixed to one outside body for marking zero. The unit adds by using the two outside stationary field coils and applying a constant dc potential to the moving coil suspension. This effectively adds the ampere turns in the field coils. Reversing one of the field coils will cause subtraction. In multiplication, the sum of the field effect (magnetic flux density) times the moving-coil current results in a deflection proportional to the product of the two input signals.

Control System Multiplexes Data Signals On Single Circuit

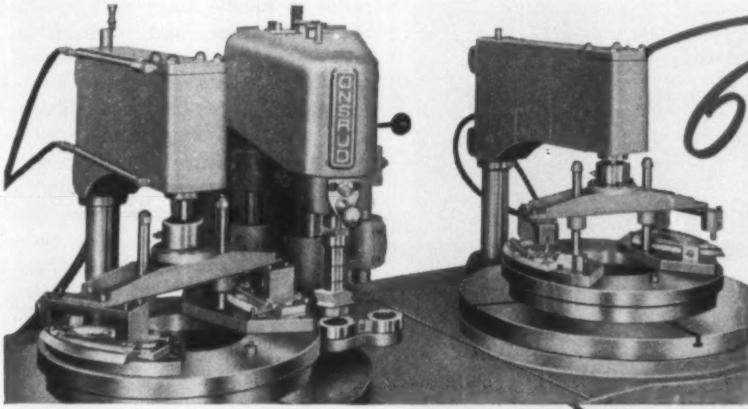
INDUSTRIAL telemetering and supervisory system that uses the same pair of wires for both incoming data signals and outgoing supervisory commands is marketed by Applied Science Corp. of Princeton. The system is particularly suited for use in continuous process operations, such as pipe line systems, oil fields, power, and water distribution systems.

The basic system can handle up to 165 on-off type controls or 17 telemetered analog signals, or combinations of both. One multiplexer samples measurements and conditions at a remote station, and, on direction from the master station, assigns supervisory commands to the proper control devices. Other multiplexers, located in the master station, assign incoming data signals to the proper indicators, recorders, or alarms, and also distribute command signals to the remote station.

Multiplexers enable one economical communications link and a relatively small number of system



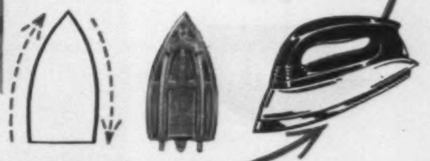
HEART of a new poultry feed mill, erected for Farmers Co-operative Association at Norma, N.J., is a new automatic formulation, proportioning, and weighing system designed and installed by Richardson Scale Co. A pneumatic system unloads bulk feed ingredients from rail cars or trucks and routes them to holding bins. Feed formulations are set up on the Richardson Select-O-Weigh Control panel, and ingredients are automatically selected and carried through a continuous sequence of batch weighings to storage bins. Outgoing bulk feeds are weighed automatically before loading on trucks. The five-story mill with "push-button" equipment has increased production by 100 tons and reduced man-hours of labor by more than 30 per cent during the first year of operation.



6 TIMES FASTER PRODUCTION!

WITH **GREATER ACCURACY:**
±0.0025" TOLERANCE

WITH **FINER FINISH:**
30 MICRO-INCHES



OPERATION and PART: production contour profile milling of aluminum hand iron sole plates

THE "Innovation" OF MACH-MIL

NONFERROUS MILLING PRODUCTION

ONSRUD A-28 CONTOUR MILLING **MACH-MIL**

Onsrud Mach-Mils require only normal tooling and low cost fixtures . . . yet increase nonferrous milling production from four to ten times, depending upon the type of part.

In the A-28 Contour Milling Mach-Mil shown here, a 10,000 RPM milling head is combined with dual-table rotary feeds for production contour milling at very low cost. The arm mounted milling head pivots automatically between tables, milling work on one rotating table while the other table is unloaded and loaded. A follower template on each table controls cutter travel through the milling cut. The A-28 is designed for parts up to 28" diameter. Work set-ups may be for single or multiple stations, depending on part dimensions. Because of rotary table feed, parts requiring milling on four sides or quadrants may be milled in one time-saving operation.

Your inquiry is invited for complete information.

ONSRUD
MACHINE WORKS, INC.
MACHINE TOOL DIVISION
7714 Lehigh Avenue • Niles 31, Illinois
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Dual table contour milling Mach-Mils are built with 28" and 18" work capacities and in choice of spindle speeds. Onsrud Mach-Mils are also offered in a wide range of types and capacities for face, straight-line and contour milling . . . with rotary feeds up to 50" maximum work capacity . . . and in standard reciprocating table feeds in work capacities to your specifications. Special machines are also supplied with indexed stations for automatic drilling and tapping in combination with milling feeds.

WRITE FOR CATALOG NO. 1162 . . . twenty-four pages featuring Onsrud Mach-Mils for nonferrous production milling.

Onsrud For doing things *better* by doing things *differently!*

MOVE LOADS

UP

OR

DOWN

AT ANGLES

UP TO

90°

WITH AN A-F *ENGINEERED* MAGNETIC BELT CONVEYOR

NON-FERROUS MATERIALS in steel containers, as well as ferrous parts and products—either unpackaged or in paperboard cartons—can now be transported at steep angles of inclination on this new A-F *Engineered* Magnetic Belt Conveyor . . . saving valuable floor space . . . relieving plant congestion . . . increasing production efficiency.

Powerful Alnico magnets, in the slider bed of this A-F *Engineered* Conveyor, hold loads securely on the rough-surface belt, which moves them up or down without the use of cleats, bars or fixtures. Magnets retain their strength indefinitely, assuring safe, positive action of the conveyor.

This A-F *Engineered* Magnetic Belt Conveyor is only one example of Alvey-Ferguson creative *engineering*. If *you* would like to have an answer to some product-handling problem in your plant—why not write A-F—today?

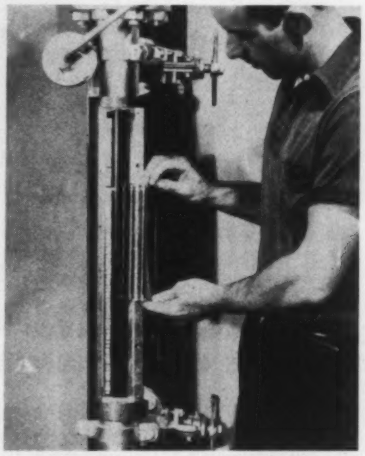
YOU CAN SEE
THE SUPERIORITY
OF A-F CONVEYOR ENGINEERING

A-F

A-F *ENGINEERED* CONVEYING SYSTEMS
Also Pre-Engineered Conveyors—
Wheel, Trolley, Roller, Belt
Metal Cleaning and Processing Machines

THE ALVEY-FERGUSON CO., 170 Disney St., **CINCINNATI 9, OHIO** and Azusa, California

parts to handle large data loads. Synchronization and calibration checks are made once each second and adjustments are made automatically. Incoming data signals and outgoing supervisory commands are multiplexed over a single pair of wires by synchronous time-division sampling devices. The system is compatible with commercial dc transducers at input and with all types of dc meters and recorders at output, as well as with data reduction and printout equipment.



STEAM-BOILER water level gage developed by Charles Engelhard Inc. consists of a nonmagnetic steel tube enclosing a magnetic float which attracts small metal reeds at left of tube. As the float varies with the water level, the reed closest to the top of the float is attracted by the magnet and is visible through a glass on the front of the gage (removed in picture). When the float moves again, the reed recedes and another reed is exposed. Unlike conventional glass gages, new unit cannot explode or become hard-to-read due to clouding.

NEW 4-page brochure describing four 16mm sound and color movies has been released by E. W. Bliss Co. The films cover the following subjects: 1. Inclinable press maintenance describing setting up a new press and inspection and preventive maintenance. 2. High production press maintenance describing correct maintenance procedures and showing operation of fast die change-over system. 3. Production of a finished automobile starter brush and plate by automatically passing a blank through an 11-station series of dies on a 250-ton

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411	441	471	501	531	561	591	621	651	681	711	741	771	801
412	442	472	502	532	562	592	622	652	682	712	742	772	802
413	443	473	503	533	563	593	623	653	683	713	743	773	803
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416	446	476	506	536	566	596	626	656	686	716	746	776	806
417	447	477	507	537	567	597	627	657	687	717	747	777	807
418	448	478	508	538	568	598	628	658	688	718	748	778	808
419	449	479	509	539	569	599	629	659	689	719	749	779	809
420	450	480	510	540	570	600	630	660	690	720	750	780	810
421	451	481	511	541	571	601	631	661	691	721	751	781	811
422	452	482	512	542	572	602	632	662	692	722	752	782	812
423	453	483	513	543	573	603	633	663	693	723	753	783	813
424	454	484	514	544	574	604	634	664	694	724	754	784	814
425	455	485	515	545	575	605	635	665	695	725	755	785	815
426	456	486	516	546	576	606	636	666	696	726	756	786	816
427	457	487	517	547	577	607	637	667	697	727	757	787	817
428	458	488	518	548	578	608	638	668	698	728	758	788	818
429	459	489	519	549	579	609	639	669	699	729	759	789	819
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Information Service

For your convenience, advertisements and items of information on new equipment, components and manufacturers' literature can be quickly identified by an *Item Number* accompanying each unit.

For additional free information circle item number on an inquiry card. Fill in your name, title, address, etc.—Drop it in the mail—No Postage Required—Your request will receive prompt attention and will be filled directly by the manufacturer.

So that you won't have to clip this issue, we will gladly send you a personal copy of any article. Just fill in the page number and title of the article you desire.

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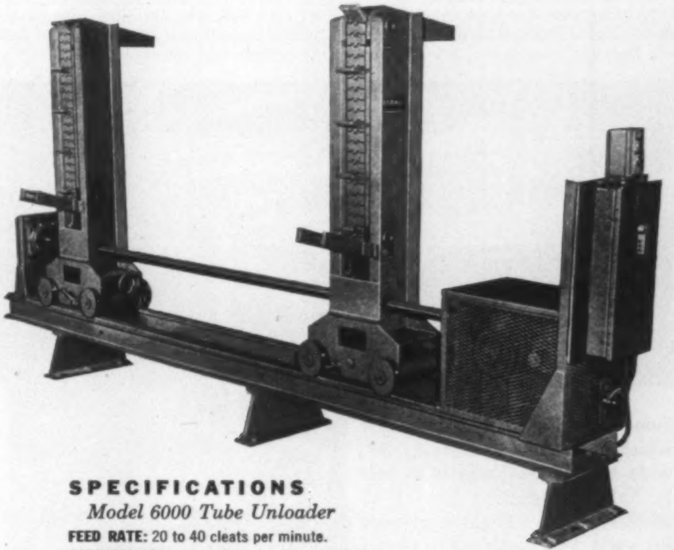
press. 4. Transfer feed presses describing how a Bliss 700-ton transfer press makes refrigerator crisper pans from coiled stock at the rate of 12 per minute.

SPOTLIGHTING PEOPLE

T. Laurence Strimple elected president of National Acme Co. . . . **Daniel C. McCarthy Jr.** named director of manufacturing planning for Chrysler Corp. . . . **V. J. Eberl** appointed plant superintendent of Robertshaw Thermostat Div., Robertshaw-Fulton Controls Co. . . . **Ralph S. Battles** elected president of Judson L. Thompson Mfg. Co. . . . **George E. Carlson** elected board chairman and **Robert W. Carlson** elected president of Minnesota Rubber & Gasket Co. . . . **Jeffrey Cohen** appointed chief development engineer of Topp Mfg. Co., a division of Topp Industries Inc. . . . **Albert J. Harcher** appointed production manager at Clevite Transistor Products Div. of Clevite Corp. . . . **E. F. Echolds** appointed chief engineer of Electro-Mechanical Div. of American Electronics Inc. . . . **Wladimir A. Reichel** appointed senior vice president of Norden-Ketay Corp. . . . **H. Glynn Wood** appointed works manager and **Robert B. O'Brien** named general sales manager of Special Products Div. of Stromberg-Carl-

---

REPEAT READINGS with an accuracy of one millionth of an inch are achieved with a new electronic gage block comparator developed by Sheffield Corp. The new instrument uses a caliper-type measuring principle. An electronic cartridge in the gage head and another in the anvil contact opposite sides of the gage block. This provides point-to-point measurement from each surface, particularly useful in gaging thin, badly warped blocks. Fine adjustments are made with knurled knobs in the instrument's base. Electronic amplifier on the left offers interchangeable amplification of either 100,000 or 10,000 to 1. The cooling-off table, shown in front of the instrument, is available as an accessory.



another automated device from Feedall

NEW AUTOMATIC
Feedall
TUBE UNLOADER

- *Cuts handling cost of transfer operations*
- *Has variable size range, selectable speed*

SPECIFICATIONS
Model 6000 Tube Unloader
FEED RATE: 20 to 40 cleats per minute.
CAPACITY: 1¼" to 3" diameter bars or tubes, 12' 0" maximum length.
CONTROLS: variable speed, automatically cycled to conveyor line. ½ hp motor, 1725 RPM. 220/440 60 cy. 3 ph.
SIZE: 19" wide x 68" high x 12½' long.

Automatic, fast and versatile . . . the Model 6000 has a lot of jobs waiting for it in high-speed parts production. It unloads, elevates, loads or transfers tubing in a wide variety of sizes and lengths, at variable speed and without costly delays or wasteful manual methods.

An exclusive feature of Model 6000 is the quick-change positioning of the elevating towers to permit handling bars or tubes any length from 3 to 12 ft. Electronic controls are readily adaptable to fit any timing cycle in standard or special applications.

There's a saving, too, in the simple "complete package" assembly with self-contained power unit. And the Model 6000 is easily fitted to existing production lines, original equipment or unusual applications.

Details describing the Feedall Tube Unloader are now available in a new catalog data sheet. Write for your copy today. Or if you have a special feeding problem, send us sample parts and brief data. Our engineers will do the rest.

Feedall
Producers of automatic feeding devices
FEEDALL, INC., WILLOUGHBY, OHIO

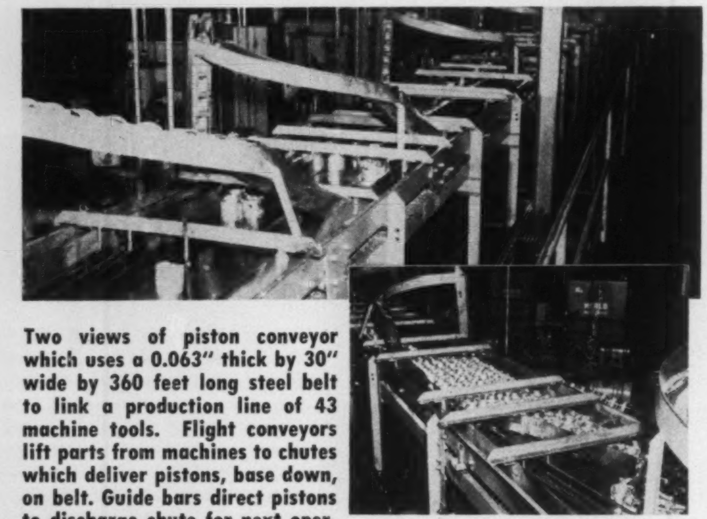
ELEVATING, BLADE, TUMBLE, VIBRATORY FEEDERS • TRANSFER AND ELEVATING CONVEYORS • SPECIAL SELECTOR DEVICES

Circle 663 on Page 17

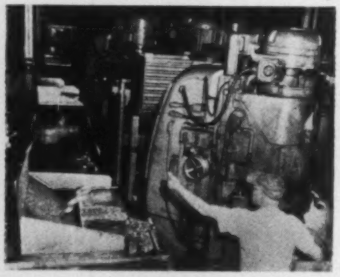
CHRYSLER CORPORATION SOLVES METAL PARTS HANDLING PROBLEM WITH SANDVIK STEEL BELT CONVEYORS

Carbon Steel Bands Carry or Backlog Engine Parts Enroute—Practically Eliminate Conveyor Wear And Downtime

At Chrysler Corporation's Mound Road Engine Plant, Detroit, two Sandvik steel belt conveyors, 24" x 60' and 32" x 360', are carrying pistons between operations; a job formerly held by rubber belt conveyors.



Two views of piston conveyor which uses a 0.063" thick by 30" wide by 360 feet long steel belt to link a production line of 43 machine tools. Flight conveyors lift parts from machines to chutes which deliver pistons, base down, on belt. Guide bars direct pistons to discharge chute for next operation.



Operator tosses partially machined connecting rods into deflector box over steel belt which carried rods to next operation. Sandvik belt is 0.040" thick by 24" wide by 60 feet long.

BOTH BELTS HAVE DUAL ROLES

Each of the steel belts is successfully performing two vital functions—automatic station-to-station parts handling plus on-belt, live storage. The low-friction, long-wearing surface of the solid steel belts permits them to slide easily under back-logged parts awaiting removal.

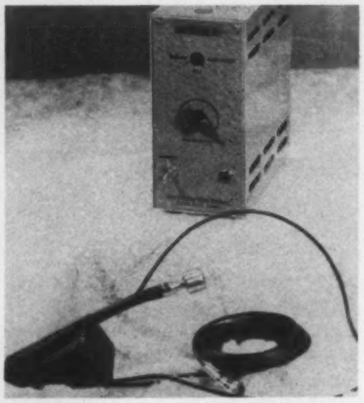
FURTHER SANDVIK INSTALLATIONS PLANNED

To date these Sandvik belts have operated with virtually no downtime and are expected to give years of service before replacement. As a result, Chrysler Corporation intends to install similar Sandvik units to handle connecting rods and rocker arms. Initial cost for steel belts is comparable to that of other types.

For further information on the use of steel belts on your conveying application, contact your nearest Sandvik office.

SANDVIK STEEL, INC. **Steel Belt Conveyor Dept. (RZ)**

1702 Nevins Road, Fair Lawn, New Jersey • Tel. SWarthmore 7-6200
In New York City: ALgonquin 5-2200
Branch Offices: 230 N. Michigan Ave. • Chicago 1, Ill. FRanklin 2-5638
3338 South Malt Avenue • Los Angeles 22, Cal. RAymond 3-9116
IN CANADA: SANDVIK CANADIAN LTD., P.O. Drawer 1330, Sta. 0 Montreal 9, P.Q.
Manufacturers of Steel Belt Conveyors For Over 40 Years



NOISE-OPERATED relay has been developed by Hunter Mfg. Co. It is designed to operate from a microphone pick-up and will work at the rate of eight operations per second. Control knob can be rotated to adjust sensitivity of unit. A double-pole, double-throw relay will open and close any desired external circuit. Relay contact points are rated at 5 amp non-inductive load.

---

son, a division of General Dynamics Corp. . . . **Paul A. Christenson** appointed works manager of Industrial Controller Div. of Square D Co. . . . **Joseph S. Jonkey,** formerly with William R. Whittaker Co., appointed production manager of Glendale Div. of Consolidated Electrodynamics Corp. . . . **John Baur** appointed director of engineering and research for Binks Mfg. Co. . . . **Joseph P. Baker,** formerly with Westinghouse Electric Corp., appointed national sales manager for Magnetic Research Corp. . . . **Robert S. Kinsey** appointed director of engineering for Utica Div. of Bendix Aviation Corp. . . . **C. Harold Hannan** appointed senior application engineer for Miniature Precision Bearings Inc. . . . **Charles T. Cosser** appointed general sales manager for Clary Dynamics Div. of Clary Corp. . . . **William G. Skinner,** formerly with General Electric Co., appointed manager of Magnet Wire Plant of Essex Wire Corp.

SPOTLIGHTING PRODUCTS

Precision drill grinding machine for applying the newly-developed "spiral point" to standard twist drills is offered by Cincinnati Lathe & Tool Co. . . . *Noise-free amplifying device,* named Versitron, which will improve the range of radar,

Circle 664 on Page 17

ERIEZ MAGNETS In Automation

NEW IDEAS from Eriez

For fourteen years Eriez has specialized exclusively in the design, manufacture and sale of high quality permanent magnetic equipment for machinery and conveyor manufacturers, design engineers, contractors and direct users. Our unique knowledge in the field of magnetic design and application has developed through experience gained by working in hundreds of a wide variety of industrial problems.

Eriez does not design, build or sell material-handling systems, but we serve people who do in areas where magnetic equipment should be incorporated. We willingly share the design- and field-application know-how gained through helping others move materials faster, more economically, more efficiently, more accurately by utilizing the inherent advantages of magnetism. And, since our engineers work closely with both system manufacturer and ultimate user, the most efficient installation is the end result.

Specifically, we produce standard lines of magnetic equipment and, in addition, design and build special components to *magnetically* convey, transfer, control, elevate, re-position, hold or re-orient basic ferrous materials or finished parts. Result? . . . materials move faster, more economically, more efficiently, more accurately—with complete control. Eriez automation units increase production, while lowering production costs. More positive hold reduces damaged parts, improves safety conditions.

Let **ERIEZ** *solve your magnetic automation problem! We'll be glad to help you in your special automation needs. For information or assistance, contact your nearest Eriez representative, or write direct giving as much advance information as possible. No obligation, of course. Eriez Manufacturing Company, 119A Magnet Drive, Erie, Pennsylvania.*

Circle 665 on Page 17

Eriez Magnetic Units provide these important AUTOMATION ADVANTAGES

First cost is the only cost

Powerful, self-contained magnets are virtually trouble-free

Magnetic strength is guaranteed indefinitely

No electrical accessories or wiring necessary

No power consumption; no operating costs

Maintenance is virtually eliminated

Less work space is needed

Positive hold permits faster conveyor speeds

Simple design, simple in function

Rugged design and construction; few moving parts

Choice of surface facings: hard or rubber coated for finished parts

Easily installed on new or existing equipment

Wide range of styles, sizes, magnetic strengths

No special skills or training needed to control, operate or maintain these units.

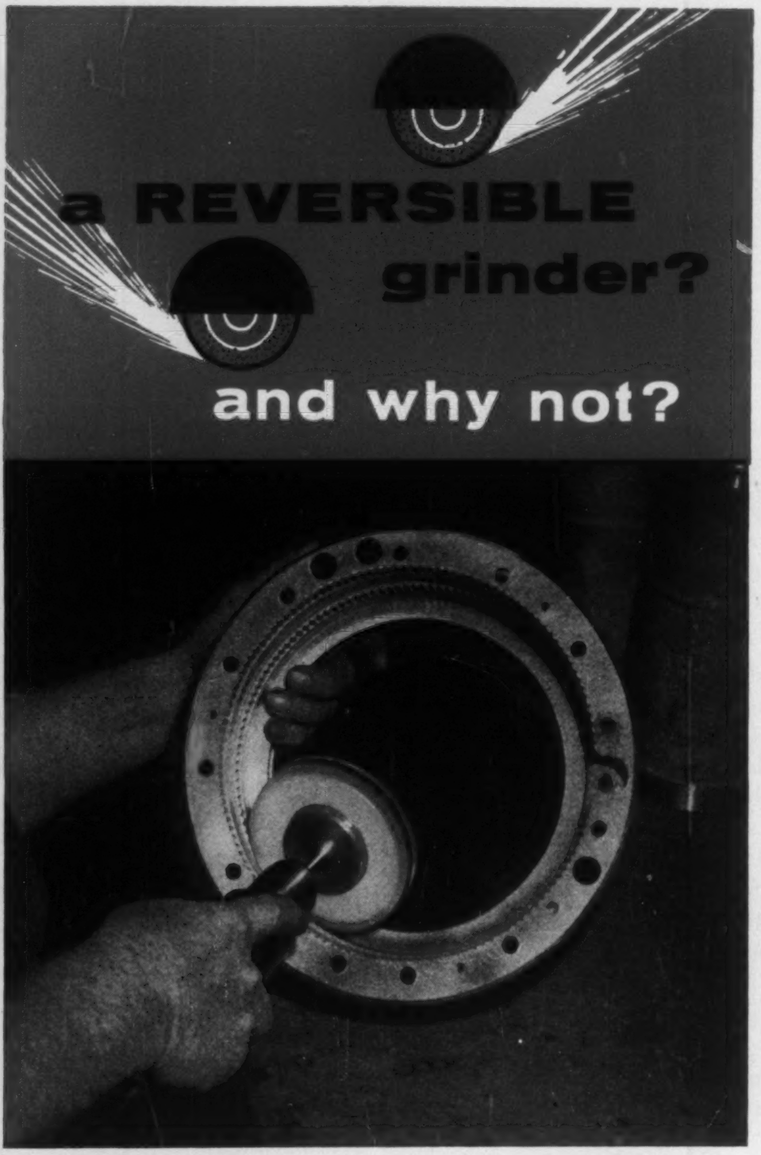
ERIEZ—pioneers and world's largest producer of permanent non-electric magnetic equipment for industry, has three major product lines to serve you:

HI-POWR MAGNETIC SEPARATORS—to remove unwanted iron from processing lines, ferrous from non-ferrous materials and iron contamination from liquids.

HI-POWR MAGNETIC AUTOMATION UNITS—to handle hundreds of materials-handling problems . . . to convey, control, transfer, elevate, re-position, etc., ferrous materials or parts during many manufacturing processes.

HI-VI VIBRATORY EQUIPMENT—to move and accurately feed bulk materials.

ERIEZ®



Both edges of the numerous splines in this pitch lock housing must be carefully deburred. The shape of the part prevents working from both ends, so an ordinary single-direction grinder just won't do. So—you simply use a Buckeye *reversible* grinder. Start the job with a grinding wheel, switch to a stainless steel wire brush, then finish up with a tampico brush—and use the same Buckeye tool all the way.

Results? These precision aircraft parts will be subjected to 2500-lb. operating pressures, and must be finished perfectly. And they are, for each part is inspected under a 25-power microscope to make certain not even the tiniest burr has been overlooked, and to see that exact tolerances haven't been disturbed. That's real finishing . . . Buckeye tools finishing!

Why AIR Tools?

Because air is everywhere, just waiting to be put to work . . . because continuous operation can't possibly harm an air tool . . . and because, if you're using Buckeye air tools, you can almost forget about tool maintenance.

For a special air tool for a difficult job, or a standard air tool for routine work, your best buy is Buckeye. Write for our new catalog.

Buckeye Tools
CORPORATION
5009 SPRINGBORO PIKE • DAYTON, OHIO

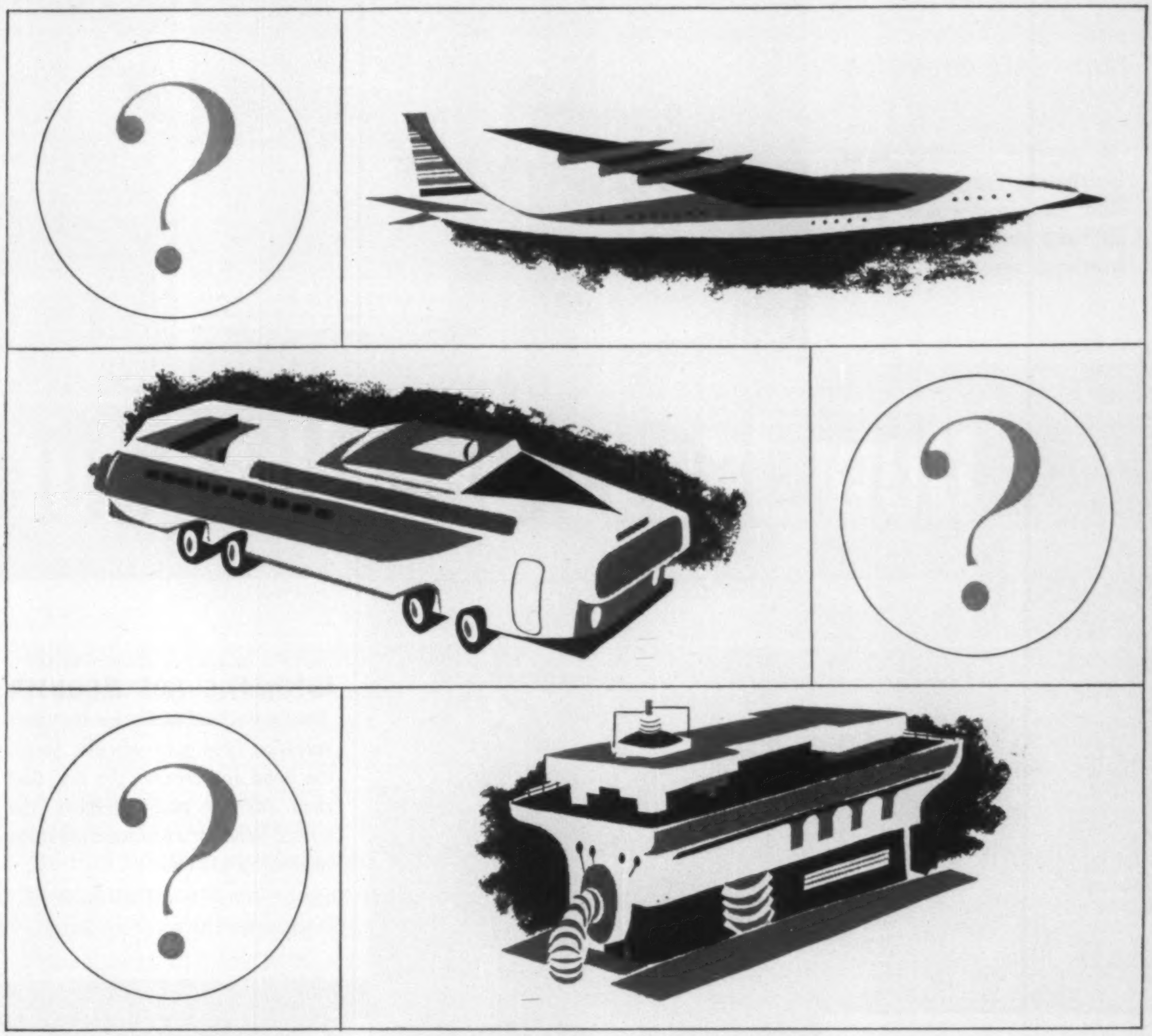
Circle 666 on Page 17

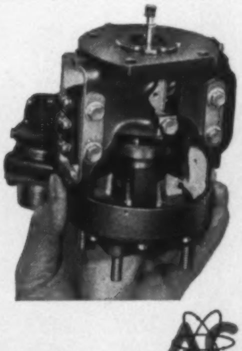
communications equipment, and other electromagnetic devices by at least three times has been announced by Electronics Div. of Advance Industries Inc. . . . *Four-way slide valve,* designed with interlock switch and manual set-up control, for actuating a variety of air powered mechanisms and equipment is available from Dixon Automatic Tool Inc. . . . *Bench-top, modular-package conveyor* that is 4 inches wide and can be expanded or shortened in 3-foot increments to suit assembly line changes is offered by Products For Industry, Stamford, Conn. . . . *Brushless alternator* with no moving parts except a solid metal rotor and especially suitable for work at temperatures ranging beyond 800F is available from Turbo-Machinery Div. of Aerojet-General . . . *Heavy duty automation cylinders* rated at 200 psi air and 1000 psi oil are available from S-P Mfg. Corp. . . . *Tiny pulse transformer* no bigger than a pea and with coil inductances to 3 millihenries is available from Pulse Engineering Inc.

SPOTLIGHTING PLANTS

Hydromatics Inc. have moved their engineering, production, and administrative activities into a new plant in Livingston, N. J. . . . **Seneca Falls Machine Co.** have appointed Technical Instruments Inc., Reading, Mass., as their representative for a new line of electromechanical controls . . . **Magnetic Circuits Inc.** have moved to new and larger quarters in Montrose, Calif. . . . **UARCO Inc.** have opened a new 80,000 sq ft plant in Watseka, Ill. . . . **General Controls Co.** have acquired Hammel-Dahl Co. as a major division . . . **P. R. Mallory & Co. Inc.** have acquired the plant, facilities and majority interest of Milli-Switch Corp., Santa Monica, Calif. . . . **Datamatic,** a division of Minneapolis-Honeywell, have opened a west coast regional office in Los Angeles . . . **Gries Reproducer Corp.** are expanding plant and production facilities at New Rochelle, N. Y. . . . **Cubic Corp.** have acquired Digital Inc. to provide a basis for development in the areas of instrumentation and automatic control . . . **Marion Electrical Instrument Co.** have moved into a new 20,000 sq ft addition in

do you need switches set off by speed





Now, a speed sensing control has been produced by AC to trigger up to four turbine engine functions at speeds ranging from 500 to 4600 rpm—within a tolerance of ½ of 1%. No other speed switch now being produced can match this AC development for sensitivity and accuracy.

Yet, the AC Speed Sensing Control is light and compact—weighing approximately four pounds. It can be mounted anywhere and is sturdily built to withstand high engine vibration without losing calibration. It will function without attention for longer time intervals than the usually recommended jet engine overhaul period.

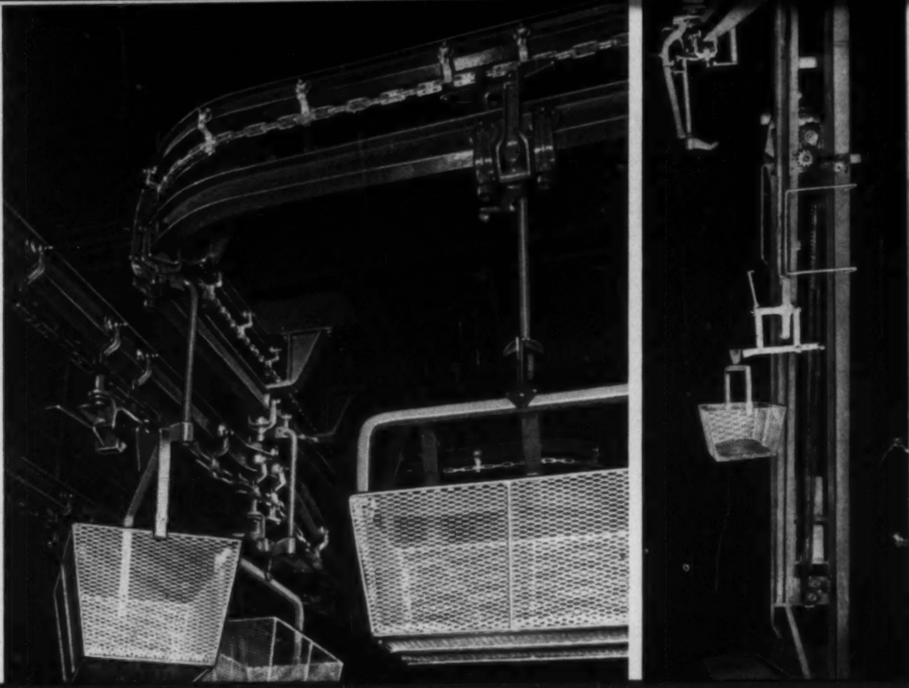
Call AC's Milwaukee plant if you have any need for automatic control of switching operations related to speed.

—Or, if you hold a degree in electrical or mechanical engineering, and think you might like to work with AC in Milwaukee, write Mr. Cecil Sundeen, Supervisor of Technical Employment, Dept. K, 1925 E. Kenilworth, Milwaukee 1, Wisconsin.

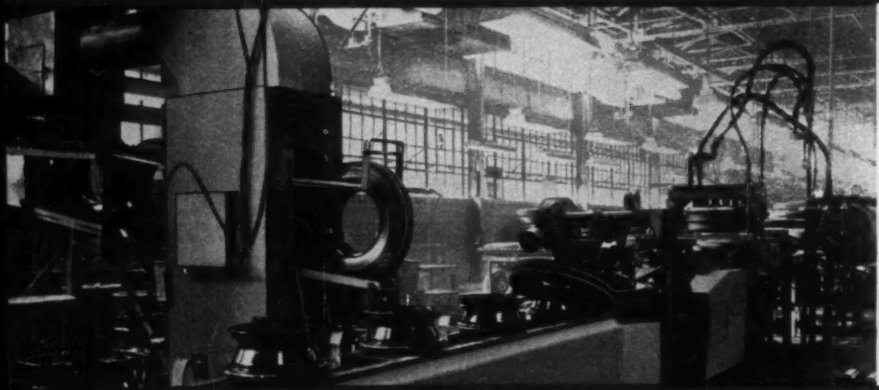
AC ... THE ELECTRONICS DIVISION OF GENERAL MOTORS

Afterburner Fuel Controls • Bombing Navigational Computers • Emergency Fuel Controls • Gun-Bomb-Rocket Sights • Gyro-Accelerometers • Gyroscopes Inertial Guidance Systems • Manifold Air Pressure Regulators • Speed Sensitive Switches • Speed Sensors • Three-Way Selector Valves • Torquemeters

TRANS-FREE CONVEYOR
Automatic transfer from live line to free accomplished without physical handling. Some installations incorporate vertical elevators which allow all work transfer in unused overhead space.

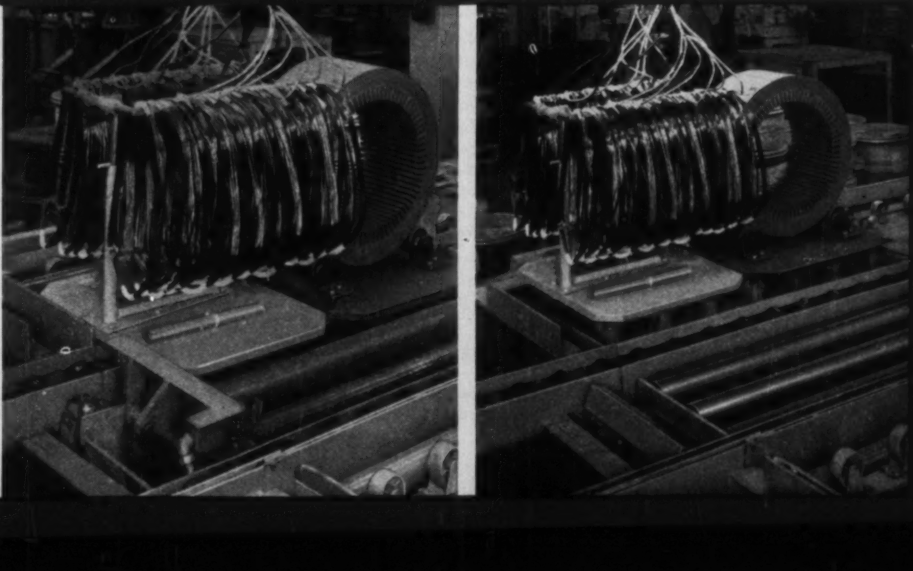


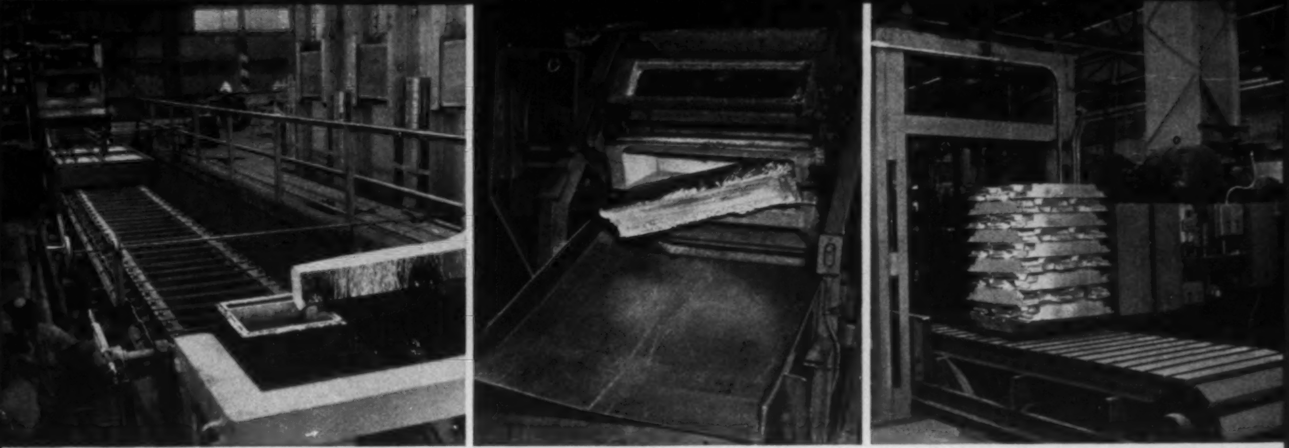
New Ideas by Allied for



AUTOMATIC TIRE MOUNTER
Another Allied first, this mounter receives tires and wheels, soaps the bead and mounts the tire, and then *inflates and balances the wheel*. Wheels are untouched from beginning to end.

LIVE ROLLER TRANSFER
In this recent installation, pallet loads are maintained on a storage bank until a work station is freed. Load then travels to work station and is automatically transferred into work area without stopping the main conveyor. After processing, work is returned to the main conveyor with no time lost, no work stoppage for physical handling.



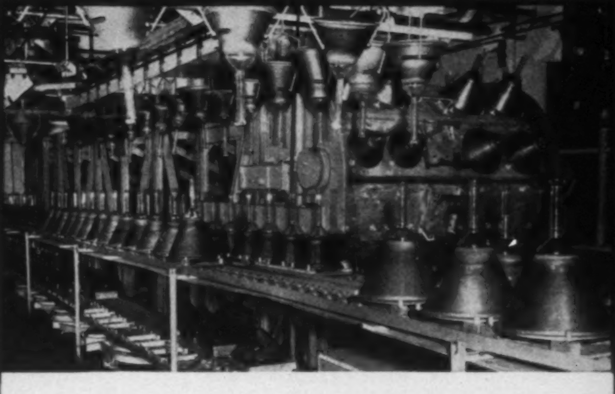


AUTOMATIC PIG STACKER—Prior to this Allied installation, ingots or pigs had to be stacked manually under hot and dangerous conditions by two 4-man teams who worked 15 minutes, then rested 15 minutes. With this automatic pig stacker, molds are poured, cooled while traveling down the conveyor line, shaken from the mold, and then stacked on pallets ready for forklift trucks, all automatically, completely without physical handling.

Automatic Product Handling

Allied has installed miles upon miles of overhead conveyors like many other conveyor companies. But length of installations alone is not the measure of the ability of a conveyor engineering team. The true measure is how they meet your individual product handling problems and solve them in a manner that will assure a maximum return on your investment. On these pages, Allied presents some of the cost-saving new ideas introduced by them in recent conveyor installations.

For more information about these and other Allied conveyor installations, please write on your letterhead.



TV SETTLER—Vibrations of the phosphorescent solution on a TV tube during settling causes ripples on the surface of the screen. Even the slightest quiver throughout this 40-foot conveyor would cause costly rejections. This Allied equipment was in operation within two months of the manufacturer's original request and has cut the rejection rate by 50% over the previous system of hand dipping.

ALLIED

ALLIED CONVEYORS

ALLIED STEEL AND CONVEYORS • DIVISION OF THE SPARTON CORP.
17361 HEALY AVENUE • DETROIT 12, MICHIGAN • CABLE ADDRESS: ALCON

Circle 668 on Page 17

57-3

ATTEND THE
1958
ASTE
TOOL SHOW
CONVENTION CENTER
PHILADELPHIA MAY 1-8

SEE all the very latest advances and improvements in more than thirty major categories of industrial products.

ATTEND top-level conferences, conducted by recognized authorities on the newest production techniques and developments.

MEET and exchange ideas with management, engineering, production, sales people from the nation's leading industrial concerns.

INSPECT the modern equipment and up-to-the minute manufacturing methods being utilized in booming Delaware Valley plants.

AMERICAN SOCIETY
TOOL SHOW * CONFERENCE '58 MAY 1 TO 8
OF TOOL ENGINEERS

Circle 669 on Page 17

Manchester, N. H. . . . **Daystrom Inc.** have formed the Daystrom-Weston Industrial Div. to centralize and expand the production of industrial instruments and recorder-controllers.

MEETINGS AND EVENTS

Jan. 6-8—
Fourth National Symposium on Reliability and Quality Control. Jointly sponsored by IRE, ASQC, AIEE, and RETMA and to be held at Hotel Statler, Washington, D. C. Additional information may be obtained from Richard M. Jacobs, Radio Corp. of America, Box 33, Moorestown, N. J.

Jan. 13-17—
Society of Automotive Engineers Inc. Annual Meeting and Engineering Display to be held at the Sheraton-Cadillac and Statler Hotels, Detroit. Additional information is available from SAE headquarters, 485 Lexington Ave., New York 17, N. Y.

Jan. 14-15—
Instrument Society of America. Yankee Instrument Fair & Symposium to be held at Hotel Bradford, Boston. Additional information may be obtained from ISA, Boston Section Inc., Box 282, Boston 1, Mass.

Jan. 22-24—
Electronic Industries Association. Second National Conference on Automation Systems to be held at Arizona State College, Phoenix, Ariz. Additional information is available from Engineering Dept., EIA headquarters, 11 W. 42nd St., New York, N. Y.

Jan. 27-30—
Plant Maintenance & Engineering Show. To be held at the International Amphitheatre, Chicago. Additional information is available from Clapp & Poliak Inc., 341 Madison Ave., New York 17, N. Y.

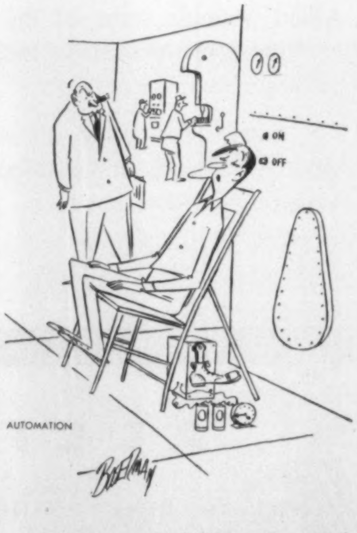
Jan. 28-31—
Institute of Aeronautical Sciences. 25th Annual Meeting to be held at the Sheraton-Astor Hotel, New York. Additional information is available from IAS headquarters, 2 East 64th St., New York 21, N. Y.

Feb. 2-7—
American Institute of Electrical Engineers. Winter General Meeting to be held at the Hotel Statler, New York. Additional information can be obtained from institute headquarters, 33 W. 39th St., New York 18, N. Y.

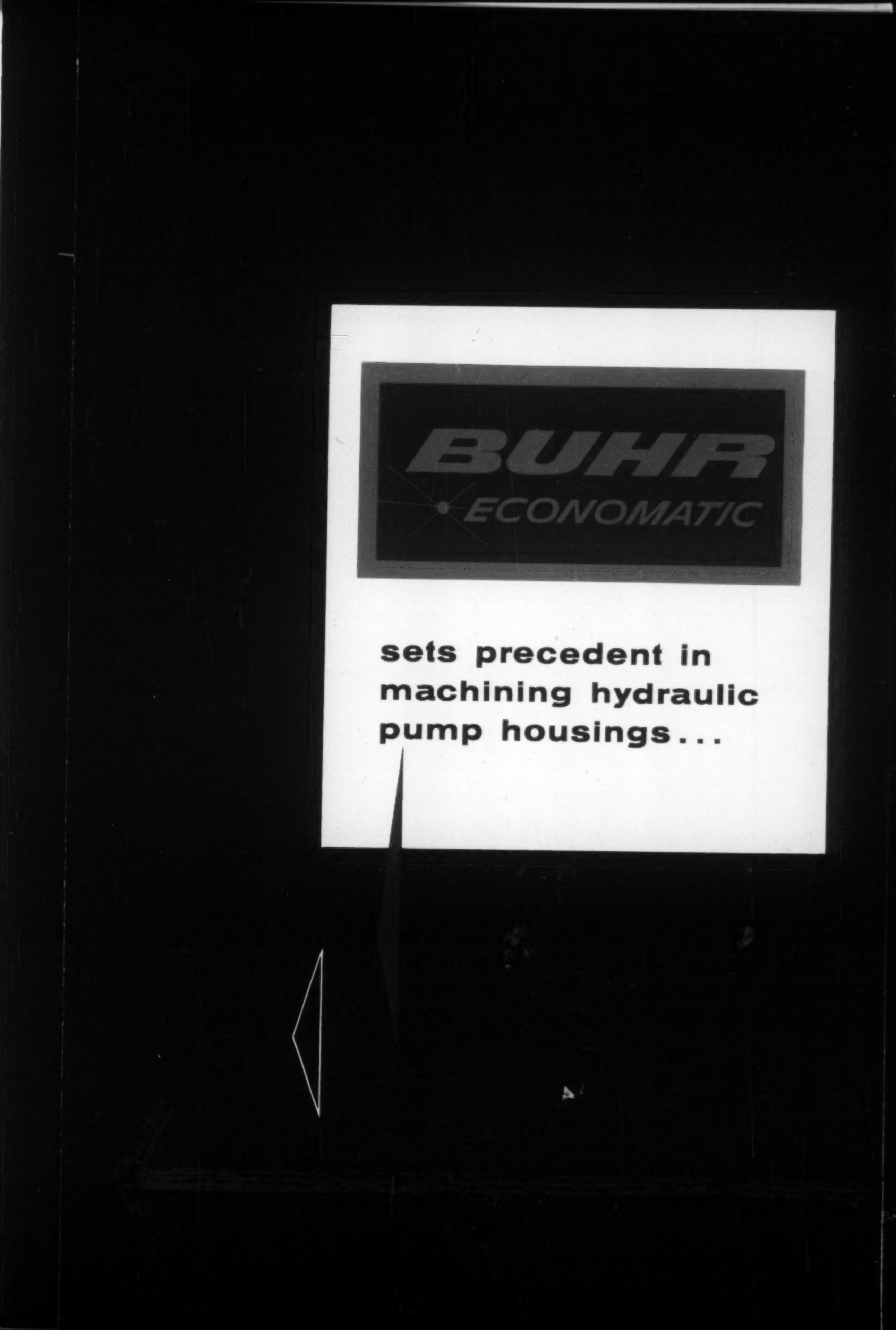
Feb. 3-4—
Instrument Society of America. Symposium on "Progress and Trends in Chemical and Petroleum Instrumentation" to be held at Hotel Dupont, Wilmington, Del. Additional information may be obtained from Bill Durkin, Fischer & Porter Co., 2011 Concord Pike, Wilmington 3, Del.

Feb. 4-6—
Society of the Plastics Industry Inc. 13th Annual Technical and Management Conference of the Reinforced Plastics Div. to be held at the Edgewater Beach Hotel, Chicago. Additional information is available from SPI headquarters, 250 Park Ave., New York 17, N. Y.

Feb. 7-8—
American Society for Quality Control. Second national conference of the Administrative Applications division to be held at Carter Hotel, Cleveland, Ohio. Additional information is available from William C. Lynam, B. F. Goodrich Chemical Co., 3135 Euclid Ave., Cleveland 15, Ohio.



Circle 670 on Page 17→

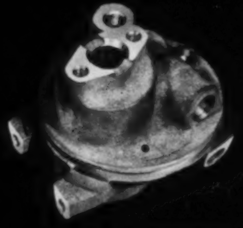

BUHR
ECONOMATIC
sets precedent in machining hydraulic pump housings...

BUHR
ECONOMATIC

36

operations on these parts...

ROUGH


FINISH

ROUGH

FINISH

on
this
machine...

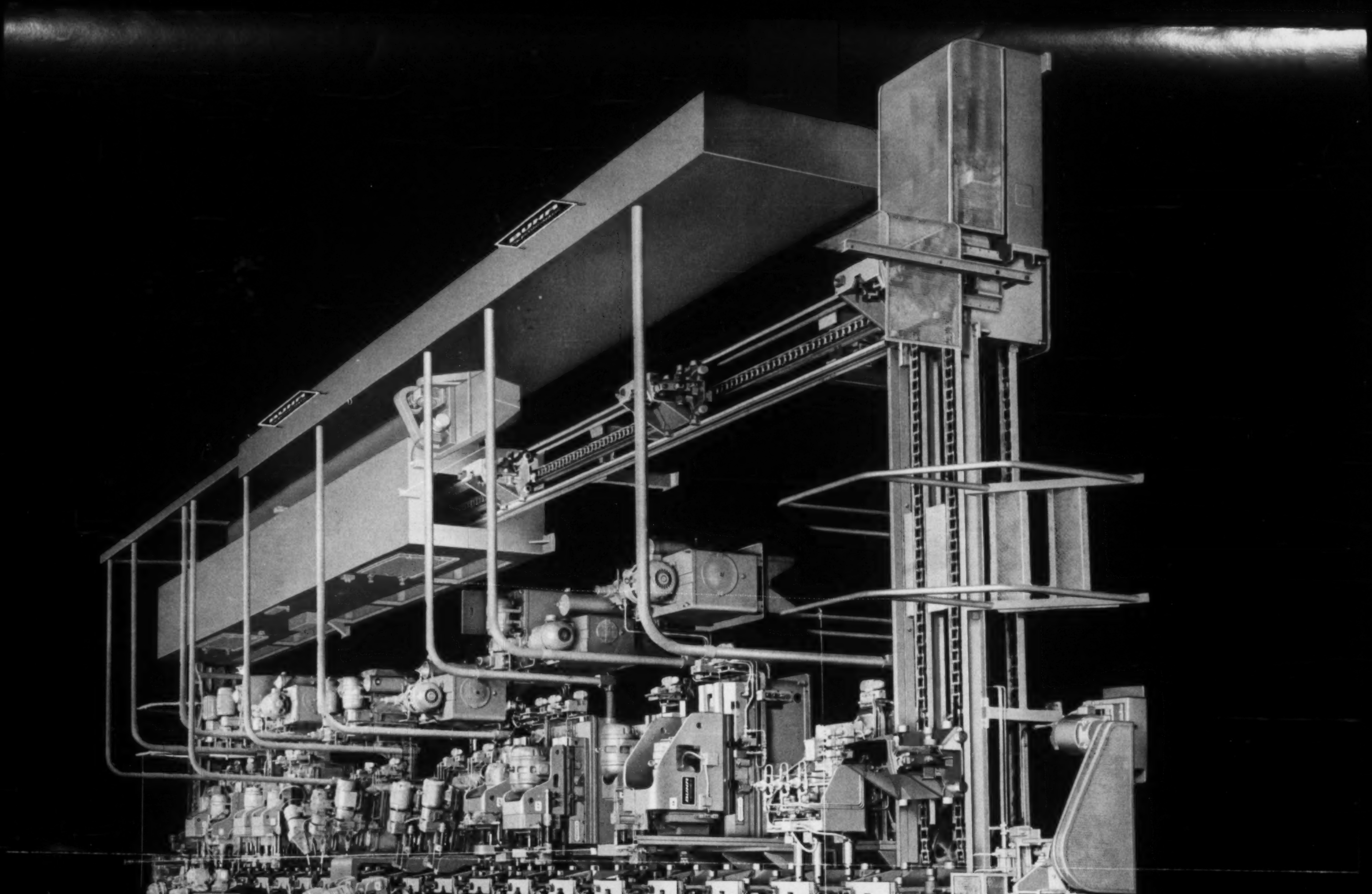
BUHR
ECONOMATIC

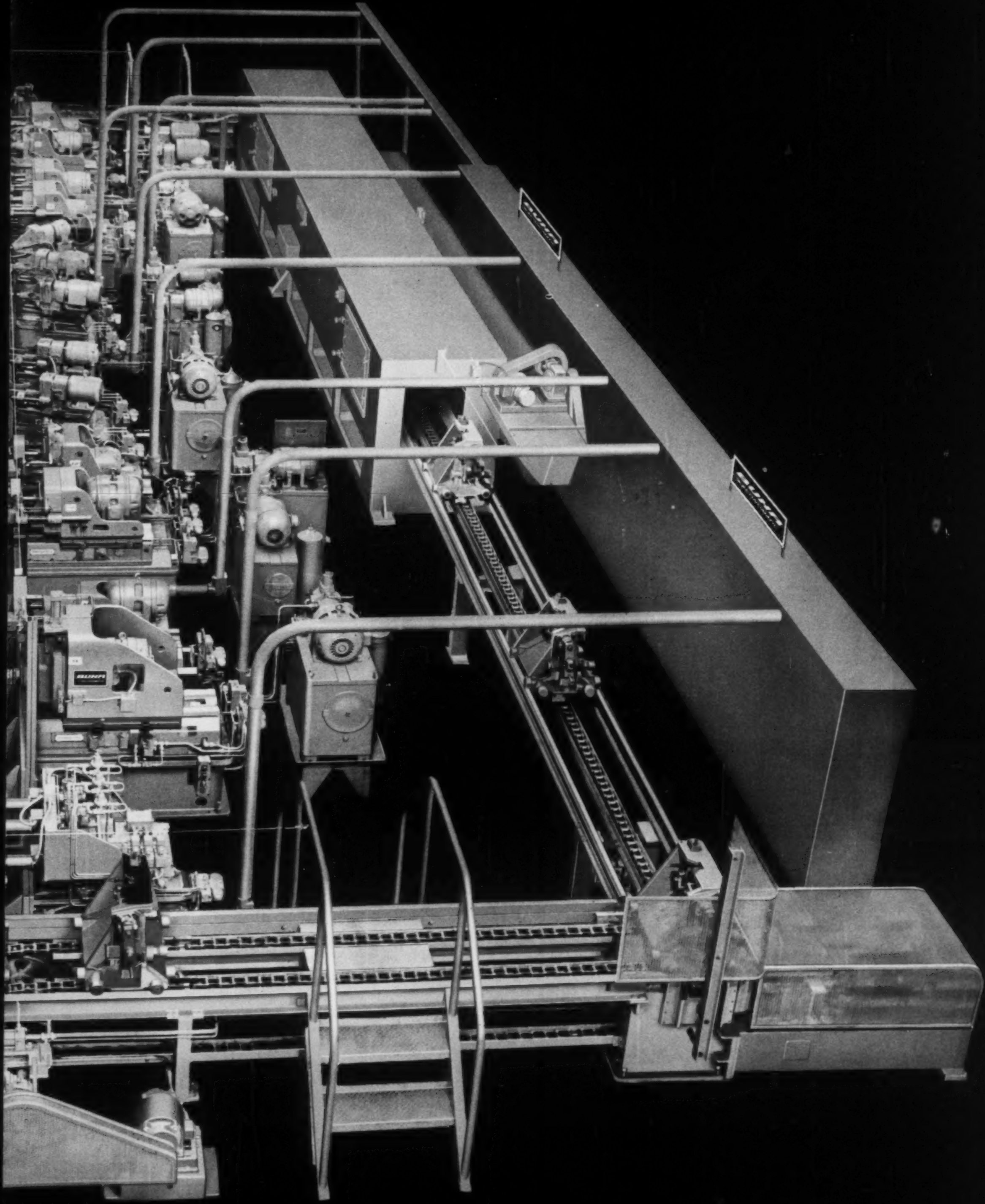
sets precedent in machining hydraulic pump housings...

sets precedent by

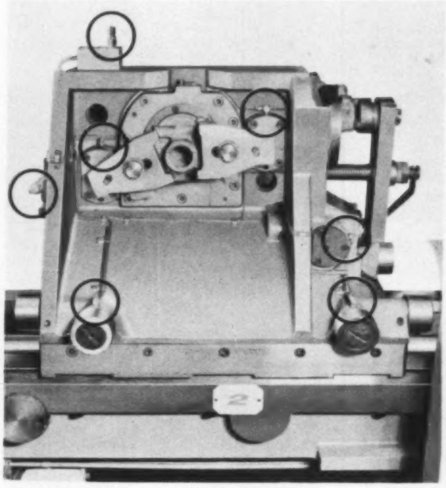
complete automatic lubrication of fixtures...

processing one part each 20 seconds!

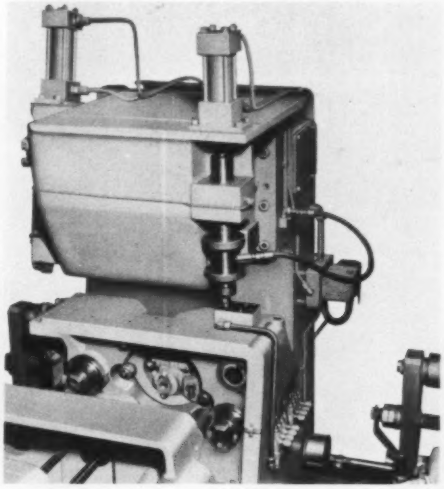

BUHR



PACE-SETTING FEATURES



complete automatic fixture-lubrication



pressure-lubrication with each machine-cycle

STANDARD FEATURES

- special Buhr sectional-base construction to facilitate future part changes
- standard and special parts interchangeable for ease of maintenance
- hardened and ground steel ways
- J.I.C. Standards throughout
- individual push-button stations on feed-units
- central-mist lubrication on spindle heads
- lube-fault warning system
- positive pallet-clamping
- spindles arranged for pre-setting of cutting tools
- automatic probe-and-blowout
- automatic fixture-cleaning system

BUHR MACHINE TOOL CO.®
ANN ARBOR, MICHIGAN
Solidly Engineered • Precision Built • for World's Leading Manufacturers

Everybody profits
...because
you
belong
in this
picture!

The publisher of this magazine is often asked what kind of a man you are . . . and how many like you are receiving his magazine.

Why is he asked?

Because the *advertisers* (whose money is his chief income) insist upon knowing the types of people (by industry or profession, by title) for whom the magazine is edited — and how many are getting it.

In order to standardize on the presentation of such information to advertisers and to have its accuracy vouched for by a disinterested third party, nearly 450 publishers have joined some 200 leading advertisers and advertising agencies in a non-profit organization called Business Publications Audit.

The purpose of BPA is to assure advertisers . . . by frequently checking and rechecking . . . that each member publisher is indeed distributing his magazine, in the *numbers* promised, to the *types* of men he promised would receive it.

The BPA symbol in this magazine means that *you belong* . . . that because of your occupational interests you are qualified, in the eyes of the advertisers, to receive it.

The advertiser can thus tell whether he's getting his money's worth.

The publisher has a better sales story to prospective advertisers because his magazine is "audited."

And you, the reader, get more value from the magazine because both the advertisers and editors, knowing what your special occupation is and what your interests are, are better able to prepare advertising and editorial material that will be most informative and useful to you.

What you can do

Publishers and advertisers frequently write to magazine readers to learn what kind of articles and advertisements appeal most. Cooperate with them — will you? — by answering their questions . . . in the interest of better communications between makers and markets.

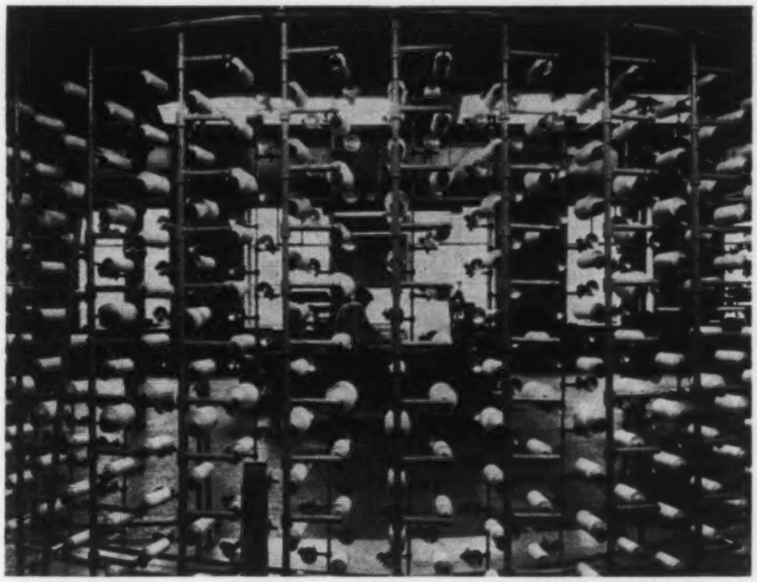
BUSINESS PUBLICATIONS
AUDIT OF CIRCULATION, INC.
420 Lexington Avenue New York 17, N. Y.

BPA

A NON-PROFIT, TRIPARTITE MEMBERSHIP CORPORATION OF ADVERTISERS, ADVERTISING AGENCIES AND BUSINESS PUBLICATIONS

notes from britain

By FRANK G. WOOLLARD
British Correspondent



British engineers and textile manufacturers have joined to produce the Crowther-Garnett half moon creel. As the picture suggests, keeping track of individual threads which might break is a major problem. Should a break occur, winding is stopped automatically and a warning light over the appropriate bobbin identifies the thread source affected.

Without Publication

IN BRITAIN a very considerable amount of automation is installed without notification to the press or even mention in the chairman's speech at the annual general meeting. In many instances, of course, the firms are small or in larger concerns the installation of automatic machinery is a gradual process. Even some of the quite large firms say little or nothing about the automation they install. This may arise from a desire to keep their competitors guessing but, more likely, it may be that they do not wish to attract the attention of trouble makers and upset their operators. It is, indeed, the opinion of many that automation—a natural development of the flowline system—has attracted undue attention and has given rise to anxieties among employees that were never justified.

Be that as it may, the writer recently had the pleasure of visiting an establishment, to remain unnamed, making automobile components on a considerable scale and found that automatic operations have been applied to, possibly, 50 per cent of the plant. The major amount had been conceived by their own engineering staff and much of it had been built in their own workshops.

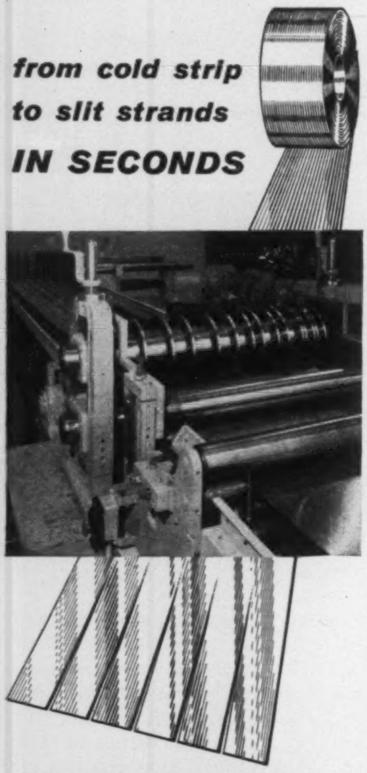
Material Stores

One of the outstanding examples was the handling of materials into and out of the stores. The method is an excellent illustration of organisation and automation combined. On entering the works the trucks are halted at a gate house where they are weighed and the details of the load are automatically transmitted to the stores control room. The trucks then proceed to a marshaling area to await a signal to proceed to a certain space at the receiving dock which is open for unloading. There is space for performing the "backing-up" operation, otherwise the trucks are operated on a one-way traffic system.

Inside the stores there are two normal type gantry cranes for handling "long" materials into horizontal racks and two stacker cranes for handling palletised materials. These comprise metal strip and wire in coil, metal strip and fibre in flat form, and also castings and purchased components. The pallets are stacked two deep and seven high and the pallet racking will accommodate any standard pallet in general use.

The crane stackers were made by the well-known German firm Demag, A.G. who are represented in Britain by Rymag Ltd. These crane stackers, which are virtually suspended fork-lift trucks, operate in aisles of 7¼ foot width between the racks. They are fitted with a slewing gear so that they can serve racks on both sides of the aisle. The lift height is 19½ feet; the fast lift being 36 fpm with a slow lift for packing the load at 4 fpm. The cross traverse is 48 and 12 fpm respectively while the lengthwise travel has four speeds viz. 24, 48, 100, or 200 fpm. Slewing is at the rate of two rpm and the lifting capacity is 1.5 long tons. When the goods are required by the production shop, the stacker crane—the forks of which can be lowered to within 1.5 inches of the floor—deposits the pallet in an issuing area where it can be picked up by a fork truck.

The bar material is stored in 12 foot lengths on pallets which are stacked between guides to a height of 7 feet. These pallets are



from cold strip to slit strands IN SECONDS

YODER ROTARY MULTIPLE SLITTERS

A Yoder slitter converts mill-width coils of flat-rolled metal into many variable-width strands in amazingly short time. Speed, coupled with great accuracy and low manpower requirements, makes a Yoder slitter an important factor in keeping production and overhead costs down.

Operated by only two men, the Yoder Type 3-48 slitter illustrated is designed to accommodate standard mill-width coils up to 48 inches wide, in a variety of metals and thicknesses. The slit strand widths can be held to within a .004" tolerance.

Even if your steel requirements are as little as 100 tons a month, the savings to be realized in time, manpower and raw material costs alone will pay for a Yoder slitter in the first few months of operation.

There is a Yoder slitter designed and engineered to meet your requirements, and to speed the delivery of "special" width stock in a wide range of large or small sizes. Send for your free copy of the fully-illustrated, 76-page booklet, "Multiple Rotary Slitting Lines."

THE YODER COMPANY
5528 Walworth Avenue • Cleveland 2, Ohio

ENGINEERING YODER MANUFACTURING ROTARY SLITTING LINES

Circle 671 on Page 17

delivered to the automatic shop by a telpher hoist on a monorail track. The telpher hoist and the stacker cranes are fitted with electronic weighing devices which record up to 4,480 lb in 5-lb steps.

The control office is built on a bridge at the receiving end of the stores at such a height that virtually the whole of the stores is under view. Moreover the control staff keeps in touch with the drivers of the stacker and gantry cranes by means of V.H.F. transmitter/receiver radio. Prior to establishing this layout eighteen men were required to handle stores; this has now been reduced to six.

There were many automatic devices in this factory, most of them consisting of standard machines linked by elevator and hopper devices. One example is that of a group of three machines comprising a bar automatic, a key seating machine, and a knurling machine. The automatic turned three diameters and threaded one end of a shaft about ten inches long. The key seater cut a Woodruff key slot and the knurling machine produced a series of splines on about five inches of the shaft.

Many of the presses in this factory are fitted with a simple but ingenious transfer mechanism. This consists of a shuttle comprising two parallel bars to which are attached a series of work-holding jaws. These shuttles hold the work pieces in position during operation then carry them to the next station. Then the shuttle bars move outwards releasing the work pieces from the jaws. The bars return to their original position and close to hold the next work piece and the sequence is repeated.

Another example of press operation involved three Bliss presses which are continously employed in producing a component of bowl shape. The presses are synchronised and are each linked by similar transfer devices wherein an ejector pin lifts the work piece from the die; two air jets blow it into a pair of guide rails which engage the flange of the bowl which slides, by gravity, until it reaches a point at which it is picked up by an inclined slat conveyor. This carries the work-piece, still prevented from falling by the guides, to a pair of pneumatically operated grips which are controlled by an escapement timed by the receiving press mechanism. When the previous workpiece is ejected the grips move rapidly into position and, on striking an inner stop, drop the pressing into the die. The grips retract as the punch descends. The trim press, in addition to the feed mechanism, is provided with a transverse belt conveyor for the removal of the clippings.

Since the presses are synchronised, and the work is continuous, the clutch and brake mechanism only comes into use at the beginning and end of a shift. There is thus virtually no wear on these components.

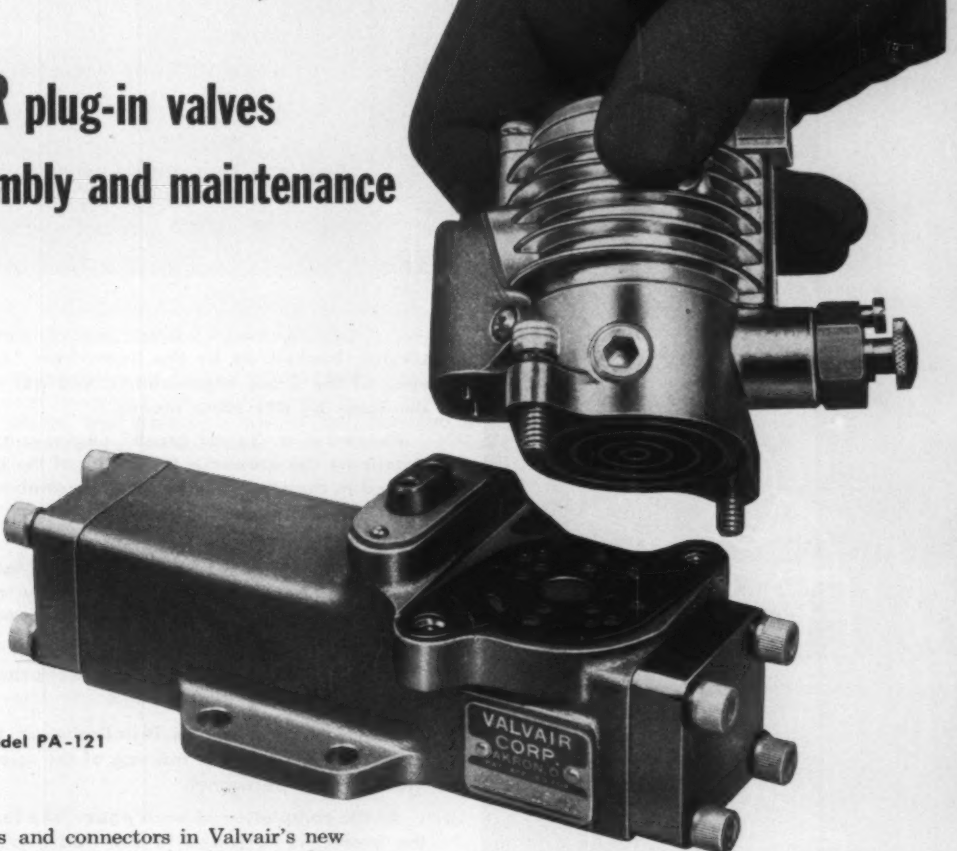
Automatic polishing and plating was much in evidence. The former by American Acme machines and the latter by W. Canning & Co. Ltd. of Birmingham.

This, then, is a quick glance at one of several companies in which automation is really well advanced but for which no publicity on their production methods has been sought.

Here and There

- The Instrument, Electronics and Automation Exhibition held in London in the spring of 1957 attracted more than 53,000 visitors. Five per cent of these were from overseas. Another exhibition will be held at Olympia April 16-25 and this will, it is hoped, be international in character.
- One might suspect that a typographical error is responsible, but "A Wonderful Automation" is the heading of a chapter in a book published in 1910, according to a recent letter to the *Financial Times.* The chapter described Jacquard's loom; the book entitled *The Romance of Modern Manufacture* was written by R. Gibson and published by Seeley & Co. Ltd.
- An extensive twelve month's research co-operation between the British Oxygen Co. and Ferranti Ltd. has resulted in advances in the field of computer controlled flame cutting machines. The new equipment which will result from this link-up will have application in all branches of heavy engineering and particularly in atomic energy and chemical engineering.

as NEW *as*
TOMORROW . . .



VALVAIR plug-in valves cut assembly and maintenance costs!

Model PA-121

Built-in plugs and connectors in Valvair's new ¼ in. Speed King 4-way control valves complete electrical circuits *automatically* . . . reduce assembly and maintenance time to a cost-cutting minimum! Permanent electrical connections are made in manifold or sub-base at assembly . . . then valves and pilots are plugged in . . . bolted down. There's no need to disturb equipment wiring for quick in-service maintenance!

Navy M bronze and stainless steel components assure 20 million cycle-plus dependability. Interchangeable pilot, with coil guaranteed against burn-out for life of valve, fits any plug-in Speed King. Coils for ac or dc, any voltage . . . 35—200 psi range . . . optional manual over-ride . . . ¼ in. cylinder ports . . . 2 or 3 station manifold with common inlet, exhaust and conduit ports, or sub-base mounted . . . valve meets JIC standards!

Whether you build or operate machines, you'll find that Valvair plug-in control valves set new standards of adaptability, performance and economy! Valvair Corp., 454 Morgan Ave., Akron, Ohio.

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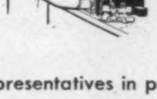

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LIST PRICE
BASIC VALVE

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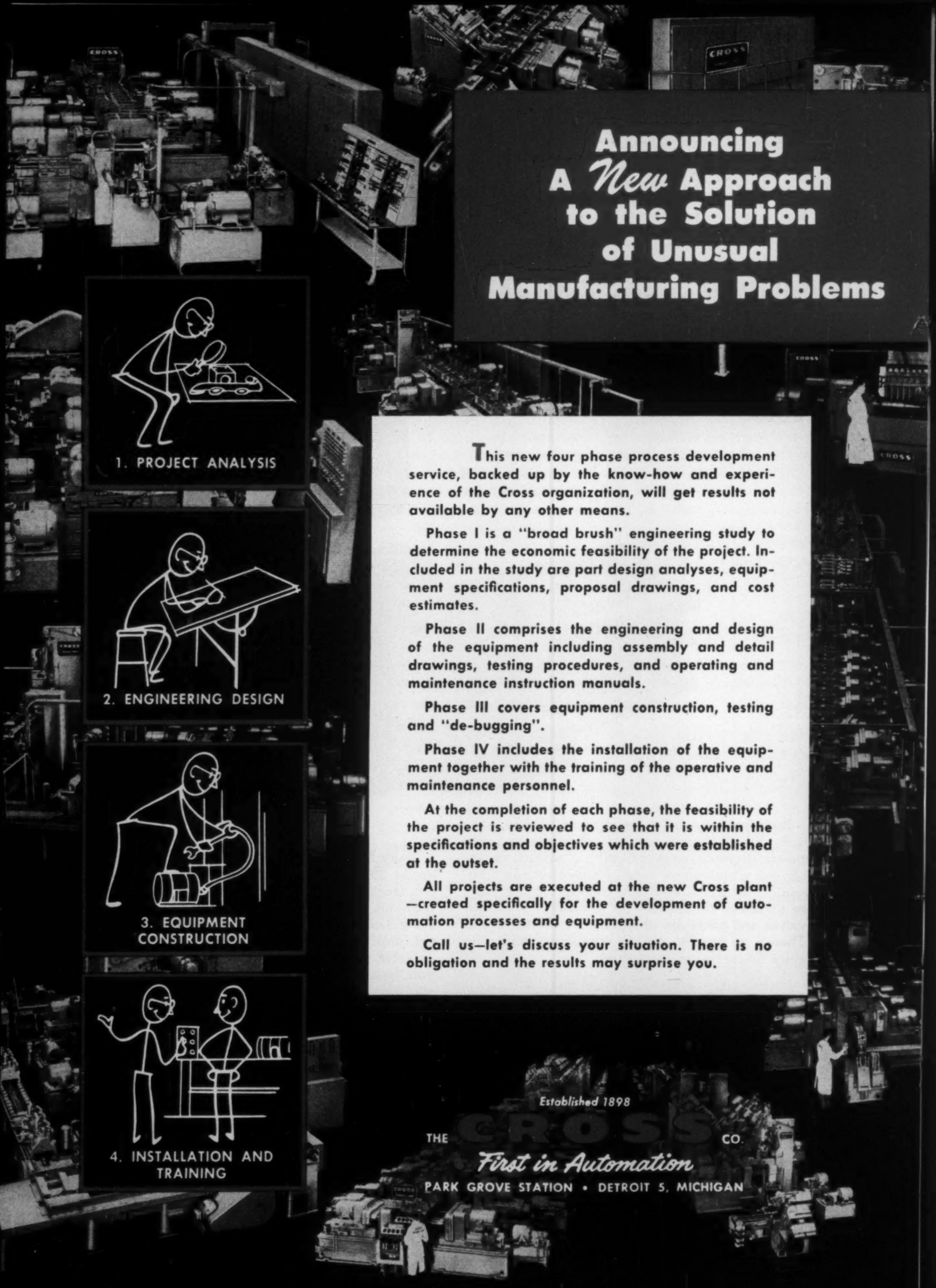


Announcing
A *New* Approach
to the Solution
of Unusual
Manufacturing Problems

1. PROJECT ANALYSIS

2. ENGINEERING DESIGN

3. EQUIPMENT CONSTRUCTION

4. INSTALLATION AND TRAINING

This new four phase process development service, backed up by the know-how and experience of the Cross organization, will get results not available by any other means.

Phase I is a "broad brush" engineering study to determine the economic feasibility of the project. Included in the study are part design analyses, equipment specifications, proposal drawings, and cost estimates.

Phase II comprises the engineering and design of the equipment including assembly and detail drawings, testing procedures, and operating and maintenance instruction manuals.

Phase III covers equipment construction, testing and "de-bugging".

Phase IV includes the installation of the equipment together with the training of the operative and maintenance personnel.

At the completion of each phase, the feasibility of the project is reviewed to see that it is within the specifications and objectives which were established at the outset.

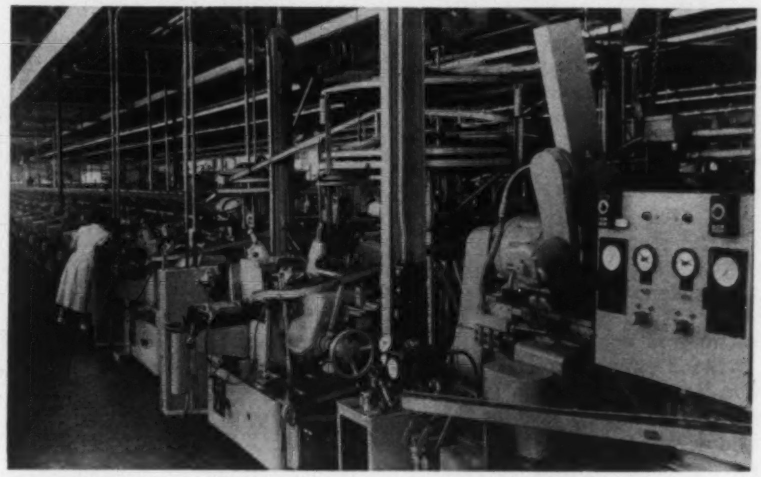
All projects are executed at the new Cross plant—created specifically for the development of automation processes and equipment.

Call us—let's discuss your situation. There is no obligation and the results may surprise you.

Established 1898
THE CROSS CO.
First in Automation
PARK GROVE STATION • DETROIT 5, MICHIGAN

detroit dateline

By **JAMES C. KEEBLER**
Managing Editor



Finishing line for cups (outer races) for Timken tapered roller bearings includes automatic cycling machines integrated into a continuous flow of operations by a system of conveyors, chutes and elevators. Except for inspection purposes none of the pieces are touched by human hands.

Orbiting Automation

DECEMBER came and went with a disappointingly small number of the usual speeches and writings on the age-old year-end theme: "I Am At Heart An Optimist."

Sputnik on the Brain

Maybe it was because 1957 wasn't the 7 million car sales year that had been predicted. Maybe it was because capital goods sales were off in some big industries. Maybe it was a mass reaction to too many flu shots. Maybe it was Sputnik-psychosis.

Certainly the fact that the Russians orbited an earthborn object took top billing, and anyone who issued an opinion on any other subject risked talking to an empty hall. Those not speaking of sputtin were putting the accent on the wrong syl-a'-ble.

Yet all the speaking of satellites raised the question of whether or not the U. S. had been putting its scientific emphasis on the wrong problem. Many remarks by noted government and scientific personnel could be summed up as saying: "If we'd a known they were sputtin we'd a baked a cake—too."

As headlines in the *New York Times* magazine section were asking taxpayers to choose between auto tailfins and rockets for moons, production engineers were wondering what good 200 assemblies per hour would be if we didn't know how to put the first one in an orbit.

This thought adds gloom to the glum. Optimistic production men used to cheer us with statistics such as the fact that though in World War II one German tank was better than one U. S. tank it wasn't better than two U. S. tanks; so we won by outproducing them. With satellites the problem was more one of basic science. Since the October launching of Sputnik was admittedly no small feat, the Muscovites were, by inference at least, feared to be ahead of us in knowledge of basic science.

Auto Scientist

Automakers are not strangers in the issues of science. Dr. Lawrence R. Hafstad, head of GM Research Staff went to Washington on October 8 to talk to the Industry Navy Research and Development Conference of the National Security Industrial Association. He had some pointed opinion on the interaction of science and engineering. Describing the operation as essentially a push-pull action with each one advancing significantly only when the other has made conditions ripe for advance, Hafstad cited an example: Considerable "useless" scientific information about the atomic nucleus was accumulated during the 1920s and 30s.

"When the scientific 'discovery' of the fission process came," he added, "all this information was available for application, and the remarkably rapid development of atomic energy both for war and for peace was the result."

He compared wartime atomic development to a Caesarean birth because "invention of the A-bomb was demanded before the natural processes for transfer of knowledge from scientist to engineer had been allowed to function."

"The scientist," Hafstad said, "was thus forced to turn engineer under duress of the emergency. In this case, however, there were two decades of backlog information available for application."

But in some current military developments, he said, "the backlog of pertinent scientific information is essentially zero."

"Yet," he added, " 'orders' are given that certain engineering problems must be solved, and bottlenecks really due to lack of scientific knowledge are attacked by regiments of engineers, at great cost to the taxpayer, and much to the frustration of all concerned."

"In my opinion," Dr. Hafstad declared, "no little part of the disillusionment with science is . . . the mistaken notion that the brute force methods so successful on engineering problems can in the same manner be applied to science."

"Engineering is the exploitation of science, and to be successful it must be given some science to exploit," he explained.

For this reason "the normally

←Circle 673 on Page 17

pacific scientific community has become so aroused over neglect or cutbacks in basic research in the military area."

Clear Challenge

Although these statements do not ring with cheery optimism or applaud the status quo, they can shed light on the Sputnik issue by answering those who would ask: Sputnik so what? What would this or any nation do with them if they could make 200 good ones per hour?

The answer to both questions seems to be: "Now—nothing." But the challenge is clearly laid down to both engineers and scientists to keep their noses to the "progress" grindstone so as not to be caught short when called on to produce.

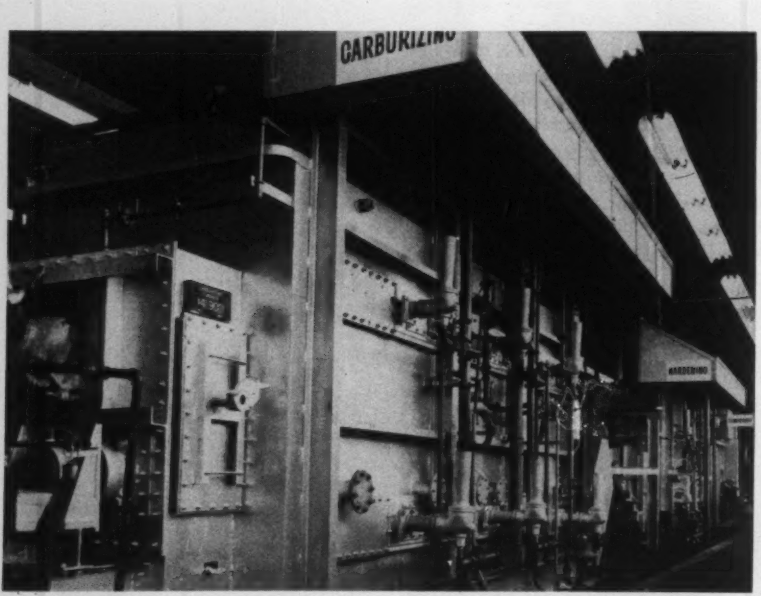
Having acknowledged satellites as a spur, there's no reason why the plus side of the 1957 ledger can't be looked at with optimism to gain spirit and bolster courage for 1958.

Of prime interest to automakers, and probably of greater significance than Sputnik to the man-on-the-seat, was Timken's revelation of their automated bearing plant at Bucyrus. Timken President Umstattd made no secret of the fact that his opening of the doors and lifting of the secrecy order was in direct answer to Russian boasts of having the world's most automated plant.

Using the Soviet's own figures Umstattd showed that Timken's output per manhour was 5 times the Russians'. What's more, the high degree of automation engineered into the production process has enabled automakers to buy tapered roller bearings for less cost if they choose one of the 14 standard sizes made in the Bucyrus plant. This they are happy to do, and the result is that all but one make of auto uses bearings made at this plant.

Engineered Benefits

This highly integrated production facility represents no small feat of production engineering development. From the plant layout for straight-through production flow; to the design of special machines to perform the operations required in the studied process; to the handling systems that tie the operations together; to the control devices that keep the system cycling; to the attitudes of the workers who supervise the operation and maintenance of this complex machinery; this plant represents a testimony that the potentials of increased automation lie available to the companies who gain the know-how to take full advantage of them.



Heat treating operations are integrated into the production lines at Timken's Bucyrus plant. Races are processed automatically through carburizing hardening and tempering furnaces before going to finishing operations.

Benefits to the company in improved competitive position, benefits to the equipment suppliers in expanded market potential, benefits to the customers in less expensive parts costs, and benefits to the nation in improved standards of living should all be given more widespread public acclaim. Advances in automation accumulated by U. S. manufacturers and equipment builders in 1957 could certainly be said to outweigh any advances in this field claimed by the Russians. Such advances may lack the essence of the spectacular that accompanies space travel but this does not make them less significant. The world's people are more surely affected by automation orbiting around them.

Planned Automation

The growing awareness that automation studies should be made on a systems engineering approach rather than on the basis of studying individual operations is a significant trend in automation. The primary questioning becomes: "How can we make connecting rods automatically?" rather than "How can we drill them automatically?" By first studying the overall process then next the details of each step of the process an overall plan is devised. Then, depending on the economics of the circumstances, the equipment can be acquired in stages or all at once.

For the smaller firms the step-by-step implementation of the program may be the only practical approach. For the GMs, Fords, Chryslers and Timkens a plant or line-at-a-time may be feasible.

In any event 1957's lessons indicate that the master planning should come first. As Dasol's Allan Harvey told the Management Div. of ASME—then the acquisition can be, "piecemeal but not patchwork."

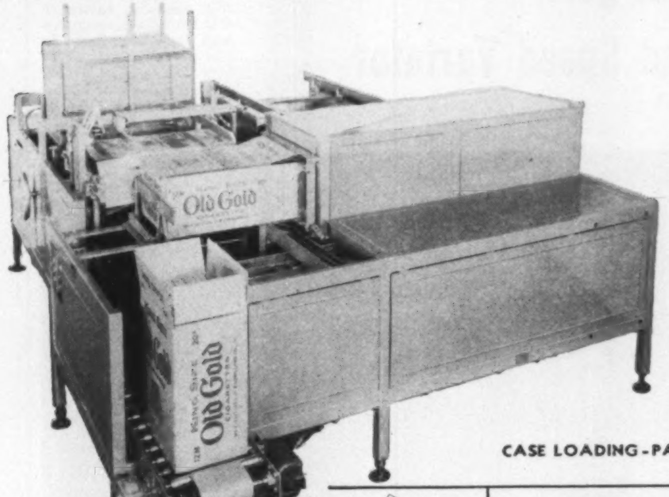
There is indeed much reason to be optimistic for 1958. Automation-minded production men must be careful however not to get drowned at the wailing wall of scientific doubts, but paddle their own canoes into the waters of advancement by continuing a free and active interchange of ideas and accomplishments that lead to more automatic operations.

Circle 674 on Page 17→

Which Packomatic solves your production line problem?

T.M. Reg. U. S. Pat. Off.

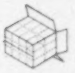
PACKOMATIC Feeder - Former - Positioner - Upender

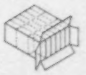


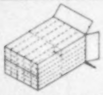
Require a fully automatic case loader?

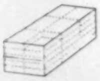
Here's a fully automatic case Feeder-Former-Positioner-Loader that is breaking records on actual production line conditions in a variety of industries. And by end-loading techniques, savings on paper board alone run as high as 28%. Production jumps dramatically with this high-speed, continuous-motion machine. Labor costs are lower, too, because except for hand-stacking corrugated shipping containers in flat form into the magazine, everything's automatic. Below are some of the end-loading patterns showing number and packing of cartons. Check with Packomatic engineers if your loading pattern does not appear here. Custom-engineering will produce a Packomatic for your product.

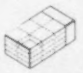
CASE LOADING - PATTERNS:

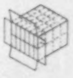

Twenty-four cartons
in 12½" x 10⅝" x 8½" case

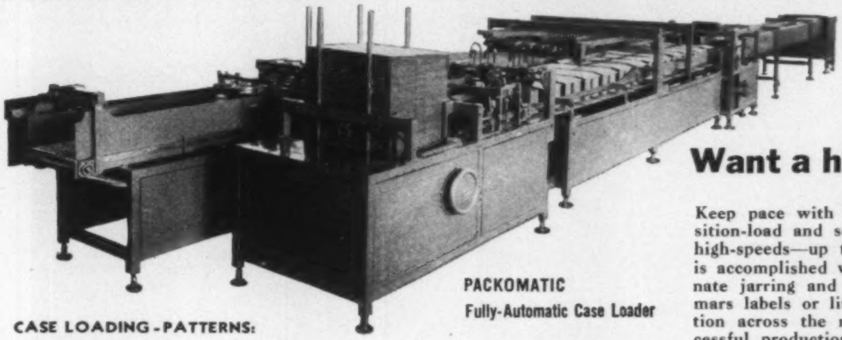

Eighteen 7 & 8 oz. cartons
in 20" x 14⅞" x 8⅝" case


Sixty cigarette cartons
King Size: 17⅞" x 11½" x 22"
Regular: 14 13/16" x 11½" x 22"


Thirty 1 lb. cartons
in 16⅛" x 10 5/16" x 7¼" case


Twenty-four cartons
in 19½" x 10⅞" x 7" case


Forty-eight cartons
in 22¾" x 23½" x 15⅞" case



PACKOMATIC
Fully-Automatic Case Loader

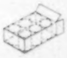
Want a high speed can line?

Keep pace with your production line. Now, feed-form-position-load and seal your corrugated shipping containers at high-speeds—up to 720 cans a minute—automatically. This is accomplished with a smooth continuous motion to eliminate jarring and bumping of cans that causes leakers and mars labels or lithographing. Machines in successful operation across the nation, (Packomatic was *first* with a successful production-line machine) end-load a variety of can sizes—from six 5-quart cans to twenty-four 12-oz. cans—in such patterns shown at left. End-loading reduces paper board costs. Automation saves labor costs. From corrugated flats to sealed containers, only one part-time attendant is required. Consider this time-money saver for your plant. We can custom-engineer a machine like this for you.

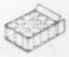
CASE LOADING - PATTERNS:

handles any can from the 12 oz. to the 5-qt. Imperial

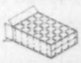
Six 5-qt. cans or gallon cans in 20⅛" x 13⅝" x 9 13/16" case and 20¼" x 13¾" x 8¼" case.



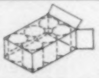
Twelve 46 oz. cans
in 21" x 13" x 7⅛" case



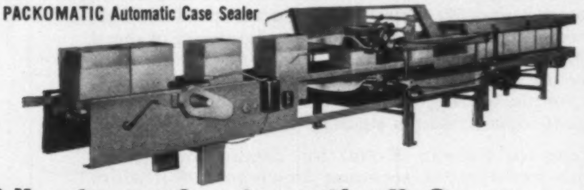
Twenty four 12 oz. cans in 16⅜" x 10 15/16" x 5 3/16" case



Six No. 10 cans
in 22 1/16" x 17⅜" x 7⅛" case

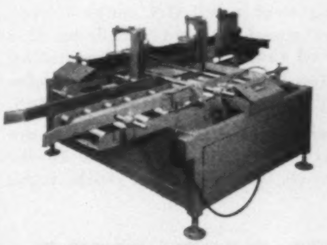


PACKOMATIC Automatic Case Sealer



Like to seal automatically?

Here's the machine for you — the **first** fully automatic case sealer proven under actual production line conditions. No operator needed to align corrugated cases, open flaps, glue, seal and discharge ready for shipment. Adjustable to a wide range of case sizes. Similar models, available semi-automatic.



PACKOMATIC 4-Side Case Imprinter with serial numbering device.

Need 4-Side Imprinting

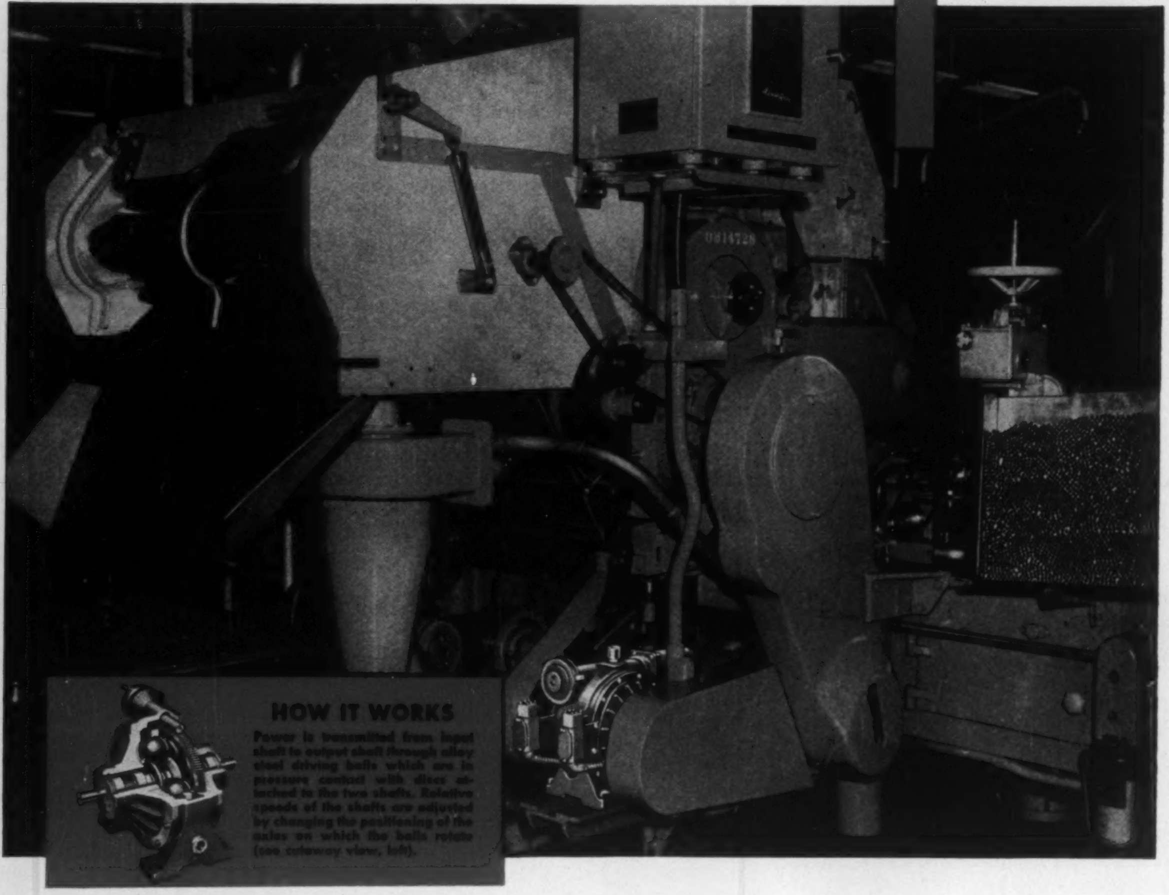
Prints either or both sides and ends of corrugated shipping containers with name and contents — in addition to imprinting a serial number. Very essential if using modern palletizing methods. The only machine of its kind. Other regular models available for minimum case imprinting requirements. Write for specs and prices.

J. L. FERGUSON COMPANY **Joliet 2, Illinois**

NEW YORK, CHICAGO, CLEVELAND, BOSTON, TAMPA, BALTIMORE, PORTLAND, DENVER, LOS ANGELES, SAN FRANCISCO, SEATTLE, NEW ORLEANS, LOUISVILLE, KANSAS CITY AND ALL PRINCIPAL CANADIAN CITIES.

AccuRay electronic brain gets muscle power from Cleveland Speed Variator

The electronic control mechanism of this cigarette machine, known as the AccuRay cigarette gage controller, built by Industrial Nucleonics Corp., Columbus, Ohio, employs Cleveland Speed Variator size 4K4, driven at 1200 rpm input.



HOW IT WORKS

Power is transmitted from input shaft to output shaft through alloy steel driving balls which are in pressure contact with discs attached to the two shafts. Relative speeds of the shafts are adjusted by changing the positioning of the axles on which the balls rotate (see cutaway view, left).

NATIONALLY famous for checking and controlling the making of Chesterfield cigarettes, AccuRay depends on a Cleveland Speed Variator for the delicate job of adjusting the tobacco feed rate in response to impulses from the gaging mechanism.

Being infinitely variable, the Cleveland Speed Variator gives stepless speeds over a full 9:1 range—from ⅓ to 3 times input speed. Output speed on this application is adjusted automatically by a regulating motor mounted on the Variator—but could be regulated manually or by remote controls of other types.

Available in eighteen standard types and sizes, the Cleveland Speed Variator offers these major advantages: 1. An extremely compact unit with input and output shafts in line and rotating in the same direction; 2. Almost any input speed up to 1800 rpm can be used—either clockwise or counterclockwise rotation; 3. Rated for constant horsepower output over a 9:1 range, or for constant output torque with a 6:1 range; 4. Infinitely variable over the entire speed range; 5. Rapid response to speed change, precise adjustment, and accurate maintenance of speed settings; 6. Long life and minimum maintenance due to absence of belts or complicated linkages; 7. Ample bearing support for overhung pulleys on either input or output shafts.

Write for Bulletin K-200 for detailed description with photographs, sectional drawings, rating tables and specifications.

THE CLEVELAND WORM AND GEAR COMPANY

Speed Variator Division, 3252 East 80th Street, Cleveland 4, Ohio
Sales Representatives in all major industrial markets • In Canada—Peacock Brothers Limited

Circle 675 on Page 17

AUTOMATION

JANUARY 1958

A Vital Link

Helping to tie together the automated system is a vital link—the handling equipment. Few automatic installations today could function properly or efficiently without the myriad of highly developed means for handling products in process.

High-capacity handling systems are needed for effectively automating operations in almost all industries: Basic metal, power generation, food, appliance, automotive, chemical, paper, textile, ore, general products, etc. In fact, but for the adaptability of most handling equipment to automatic systems, manufacturing costs in these industries today would be prohibitive.

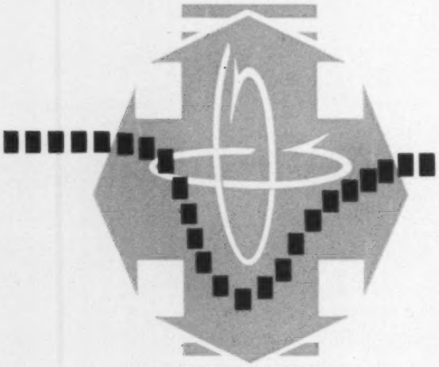
Handling devices as such, consisting of a wide variety of conveying, elevating, and feeding equipment, are employed by the engineer much as "tools" to achieve an economic organic processing system. These tools can be used in all kinds of combinations contingent upon the nature of the material, product or package and the required functions of the system.

Today's integrated handling system requires a high level of engineering ingenuity to insure complete compatibility with the productive machine sequence and the desired level of automatic control. Few systems are exactly alike. Engineering the automated line calls for thorough knowledge of the tools of handling as well as understanding of the particular product to be handled.

Systems can be developed with varying levels of automatic operation or control depending on the production requirements and basic functions to be performed. Experience has proved, however, that the degree to which handling systems should be automated or integrated into automated lines is limited only by such factors as market stability, first cost, production economics, and flexibility required in the basic processes used.

EDITOR

AUTOMATION



INTEGRATED HANDLING

There are three key phases to be considered in the development of automated production facilities. 1. The processing steps and production machines. 2. The handling arrangement or devices. 3. The automatic control system. Last May AUTOMATION presented a group of articles on evaluation of production equipment. Last September a specialized group of articles were devoted to instrumentation and control. In this issue the handling phase is given specialized treatment. Handling is a broad subject in itself, but the increased emphasis industry is placing on automating production processes focuses attention on integrating handling operations into the production line. This situation makes it mandatory that automation minded engineers be quite familiar with handling techniques. *First* is an article on the use of magnetic forces in handling operations. *Second* is a description of handling small parts for assembly. *Third* is discussion of the integration of machines into an automatic line. *Fourth* is an article on the handling of bulky or awkward parts. *Fifth* is a description of pneumatic handling systems for bulk material. The scope of integrated handling is revealed by the wide variety of applications covered in this specialized group of articles.

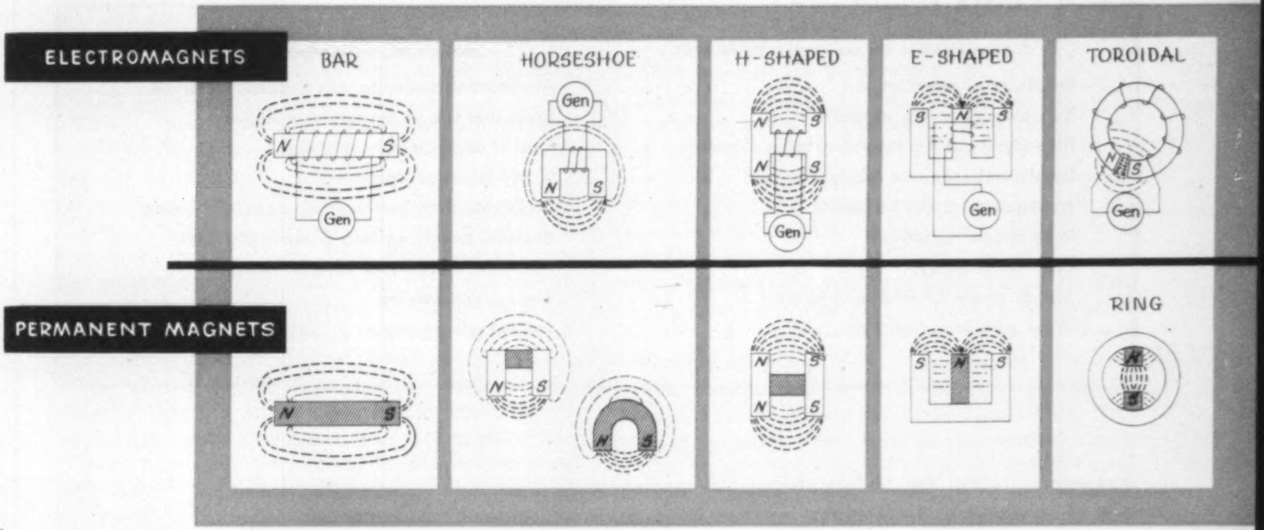


Fig. 1—Common shapes of permanent and electromagnets. In these diagrams, cross-hatched areas represent permanent magnetic material; other areas are soft iron. Heavy dashed lines represent primary or useful magnetic field; lighter dashed lines are secondary fields of force.

MAGNETIC HANDLING DEVICES

By LESTER R. MOSKOWITZ and ARLO F. ISRAELSON
Chief Development Engineer **Chief Engineer**
Eriez Manufacturing Co.
Erie, Penna.

Research has led to improved magnetic materials and devices with a large potential in certain areas of the broad field of materials handling. The variety of applications discussed in this article suggests the range of practical uses for magnetic forces.

APPLICATION of the principles of magnetism to the solution of industrial problems reflects the growth of a technology that parallels the expanding field of automation. Magnetic devices have proved to be versatile tools that can cut costs and improve performance in achieving unique solutions to difficult production problems.

Magnetic equipment is used in automation to perform one or more of the following basic operations: Separation, conveying, control, holding, and lifting. The usefulness of magnetic equipment in automation applications is based upon a number of distinct advantages. As can be seen from TABLE 1, which lists both advantages and limitations, simplicity heads the list of advantages —an important attribute for trouble free operations in mechanized production.

The detailed design of magnets is a highly specialized science that is beyond the scope of this article. Nevertheless, some basic consideration with regard to ferromagnetic materials and

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*Since the preparation of this article, Mr. Moskowitz has resigned from his position at Eriez Mfg. Co. to form the industrial consulting organization, L. R. Moskowitz & Associates. His association with Eriez continues on a consulting basis.

TABLE 1

ADVANTAGES OF MAGNETIC EQUIPMENT	LIMITATIONS OF MAGNETIC EQUIPMENT
Simplicity of construction.	Applications limited to ferromagnetic materials.
May produce forces without contact.	Force that can be developed is limited.
High forces can be developed in small spaces.	Limit to distance of force action.
Highly uniform forces can be obtained.	Costly for some operations.
Maximum force can be limited.	Lacks selectivity between ferromagnetic objects.
High degree of control.	Residual magnetism may produce problems.
High adaptability.	Adhesive tendency of objects handled.
Simple means for release of forces.	Stray magnetization.
Wide latitude of operation.	Limited release rate.

magnets is useful for understanding the application of magnets to automation.

Types of Magnets

There are two common methods for producing magnetic fields. The first of these methods rests on Oersted's discovery that an electric current flowing in a conductor produces an electromagnetic field around the conductor. When the wire is formed into a coil and an iron core is added, the common form of industrial electromagnet is produced. The second method is by use of the so-called permanent magnet materials. The basic concept that describes the magnetic effect in either the iron core of an electromagnet or in the body of a permanent magnet is illustrated in the accompanying box.

Electromagnetic products have changed relatively little in the past few decades. Except for specialized cases involving ac power, most electromagnets in industry require a source of dc power. The primary changes have been in improved wire coverings, such as the introduction of silicone and glass, which permit high operating temperatures, etc. On the other hand, in the last decade there have been revolutionary developments in permanent magnet materials. Starting with the introduction of Alnico I, a whole family of high power permanent magnet materials have been introduced. Newest among these are "ceramic" permanent magnet materials which are characterized by their shallow but strong holding forces and high resistance to demagnetizing influences. New also are the oriented iron particle magnets which offer many interesting approaches and improvements for the design engineer. Both of these new materials are still in the development stage and not yet commercially available. Many permanent magnet materials are in wide use today, each material having characteristics specifically tailored to certain applications. Alnico V has proved to be the most versatile and generally used material of this type. Both electromagnets and permanent magnets have characteristics that present advantages and disadvantages, TABLE 2.

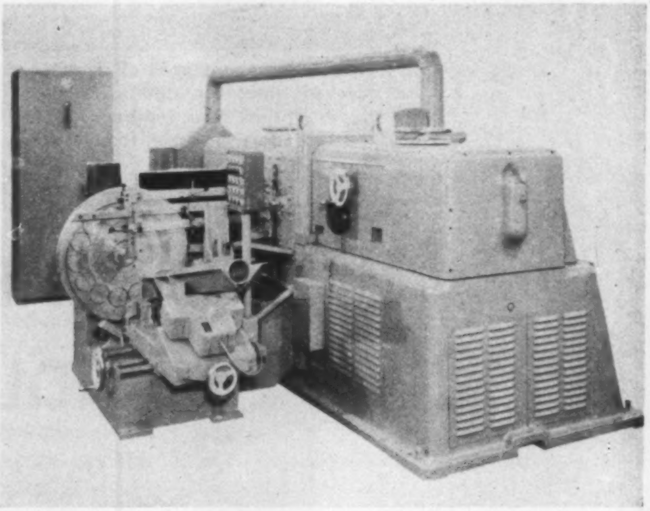


Fig. 2—Simplicity of magnetic devices is illustrated by this application in which metallic rings in trough are individually picked off and transported in oriented manner to grinder feed mechanism.

Magnets (electro or permanent) may assume virtually an infinite variety of physical configurations, but all of these are essentially variations or combinations of the basic types shown in *Fig.* 1. In addition to the primary or useful magnetic fields produced in each configuration, secondary or leakage fields exist in any magnetic circuit. These leakage fields are often difficult to avoid or reduce, although they can be minimized by proper magnet design. These leakage fields are not useful in industrial equipment, but must be given consideration in the design stage or the proper function of such equipment may be severely limited.

The shape, field depth, and field strength of the primary magnetic field of a magnet can be arranged for specific tasks through changes in the configuration and the design of the magnet assembly. For example, a magnet intended for separation purposes must have a relatively deep field, moderate holding power, protection against "wash-off" and maximum pulling power. However, a magnet intended for lifting sheet steel must be designed for a shallow field and highest possible holding power.

These two important fundamental concepts should be borne in mind in consideration of magnets for automation: 1. The *inverse square law* which states generally that the force or pull of a given magnet is inversely proportional to the square of the distance from that magnet. 2. The *saturation effect* which limits the amount of magnetic field that a ferrous object or material can carry and hence limits the maximum force that can be exerted on that object.

The inverse square law operates to limit the distance through which appreciable useful magnetic forces can be applied. The saturation effect is most commonly overlooked in automation considerations. Frequently a few large magnets will be used with resultant local saturation (and hence limited force developed) when a multiplicity of small magnets that do not saturate their local areas would provide appreciably greater total forces.

▶ Advantages

Magnetic equipment is generally fairly simple in construction. Even the most complex magnetic units are simple in comparison with mechanical devices performing similar functions. Frequently gears, linkages, arms, jaws, etc., are eliminated or replaced through the use of magnetic units. An excellent example of this is the magnetic disc used in machine tool application, *Fig.* 2.

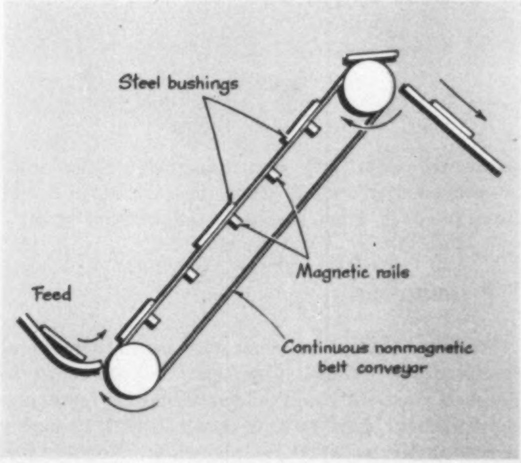


Fig. 3—Elevating conveyor illustrates the valuable attribute of magnetic devices that produces useful forces on an object without physical contact.

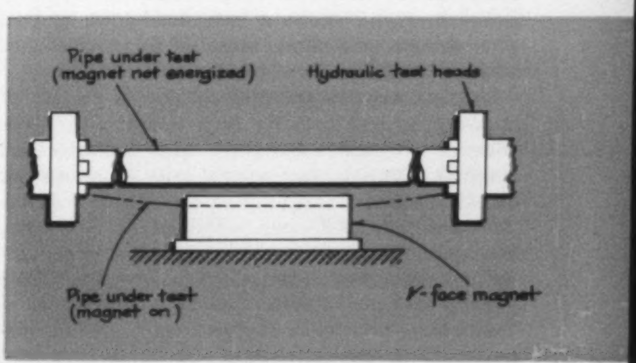

Pipe under test (magnet not energized)
Hydraulic test heads
Pipe under test (magnet on)
V-face magnet

Fig. 4—High forces obtainable with magnets led to their use in clamping pipes undergoing hydrostatic tests. Faulty pipes which cannot withstand sudden hydrostatic pressure must be restrained from movement by jet forces which develop at fractures.

Magnetic equipment may frequently be used to produce forces or action without direct contact with the object to which the force or the action is applied. For instance, it may be used to act through the walls of tanks or pipes without the use of complex seals or bearings. This is well illustrated by the use of permanent magnets placed behind nonmagnetic conveyor belts, *Fig.* 3, so that ferrous parts are conveyed, controlled, or oriented at any slope or even suspended from the lower side of the conveyor.

With magnetic equipment, high forces can be developed in small spaces where limitations frequently preclude the use of mechanical force producing devices. The V-face electromagnet used in high pressure hydraulic testing of pipe, *Fig.* 4, illustrates a case where holding forces up to 600 lb can be produced in a space approximately 6 by 10 by 10 inches. In this operation, pipes are placed between two nozzles which engage the ends of the pipe and suddenly direct water into it at 2500 psi or higher. When a defective pipe is under test the results can be rather spectacular since a break or hole on the bottom side of the pipe will cause the pipe to be projected into the air in a very dangerous manner. The use of the holding magnet avoids such occurrences, and eliminates old-fashioned mechanical clamping methods.

Magnets may be used to produce highly uniform forces or actions. Point or highly concentrated forces such as occur with mechanical devices can be avoided. In the example of a magnetic conveyor, the holding force is provided over a distance of many feet and kept uniform over the entire distance. In many cases, as in this example, a uniform force-producing means may be of practically any length.

Safety releases and maximum force limits can readily be incorporated in magnetic units without clutches, shear pins, or similar devices. Further, exceeding the force producing limit of magnetic equipment does not result in any physical harm to the magnet. In the event a magnetic holding device is subjected to a load greater than

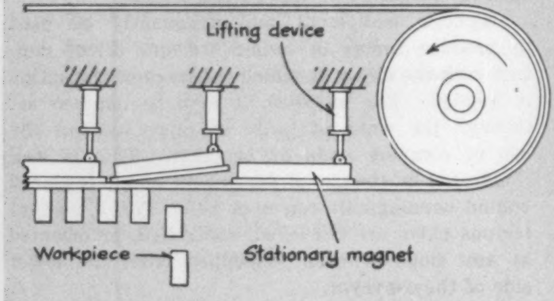


Fig. 5—Simple adjustments or motions can control magnetic devices. The illustrated conveyor arrangement allows parts to be discharged at a predetermined point by positioning the proper magnet so that the part is moved out of the magnetic field at that point.

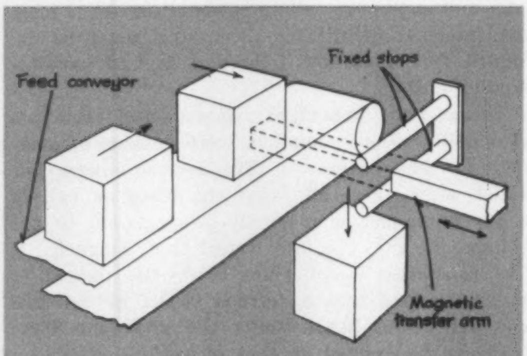


Fig. 6—Another type of simple arrangement used to release parts from magnetic elements is based on mechanically restraining the part while the magnetic element continues to move.

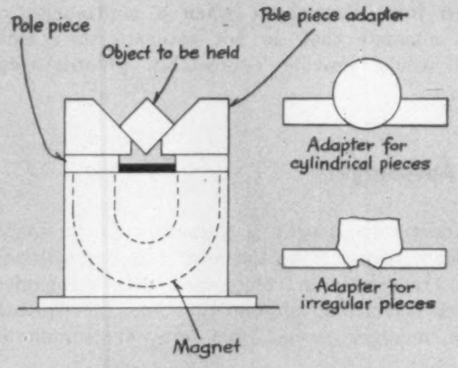


Fig. 7—Basic magnetic devices can be equipped with simple adapters to improve holding characteristics for special uses.

its holding power, the magnetic device will simply "let go" without any damage to the holding magnet itself. When using mechanical means, such as fingers, overloading to the point of failure will result in actual physical damage to the device itself. With magnets there is no repair problem.

Magnets permit a relatively high degree of control of force or action magnitudes by the means of simple control devices. Exact reproducibility of cyclic forces is practical since no changes occur in such forces due to wear. *Fig.* 5 shows a relatively simple arrangement which illustrates this principle. With this magnetic conveyor, parts can be automatically discharged at predetermined points by solenoids or cylinders which elevate sections of the permanent magnets. Any mechanical device capable of raising the magnet ½ to 1 inch can be used.

Magnets provide means for simple, quick, and complete release of holding forces. With electromagnets, this is accomplished by simply disconnecting the source of electrical energy. With permanent magnets it may be accomplished by mechanical means as shown schematically in *Fig.* 6.

Magnets are highly adaptable to a variety of operations by simple changes in external magnetic elements. *Fig.* 7 shows a basic hold-down magnet with various pole pieces attached to provide ideal holding conditions for a variety of items.

Magnets may be operated in a wide variety of atmospheres and in fairly high temperature areas without problems associated with linkages and bearings. This is particularly true of permanent magnets which can readily be operated up to temperatures of 750F and subjected to vibration, shock, and corrosive atmospheres. A pipe conveyor system, *Fig.* 8, is used to remove pipe from a hot dip galvanizing bath. This eight-roll system includes three permanent magnet rolls located in close proximity to the galvanizing vat where high temperatures exist; five electromagnetic rolls, actuated by a flag switch, drop the pipe after it has been removed from the high temperature area.

▶ Limitations

Magnetic equipment is not without its limitations. One obvious limitation is that the object to be handled must be wholly or partially of a ferromagnetic element, namely iron, cobalt, nickel, or highly magnetic alloys of these elements. Fortunately, a very large percentage of the materials used in industry are of a ferromagnetic material or have sufficient ferromagnetic parts so as to be readily handled by magnets. Other limitations of magnets are shown in TABLE 1.

There is a practical limit to the force that can be developed by a magnet. The maximum force is not only a function of the magnet, but a function of the size, shape and composition of the item to be handled. This practical limit is imposed by the amount

TABLE 2

Comparison of Electromagnets and Permanent Magnets

PERMANENT MAGNETS

Advantages

- No source of electrical energy required.
- May be operated in high temperature areas.
- Magnetic force always present, unaffected by power failure.
- No electrical connections or slip rings required.
- No aging effects.
- No maintenance requirements.
- Insensitive to shock, vibration, and similar mechanical forces.
- No operating cost.
- No elaborate control circuits required.
- High magnetic forces per unit space in small sizes.
- Low cost of small units.
- No problem with hazardous atmospheres.

Disadvantages

- Field strength not readily controlled except by mechanical means.
- Design art is highly specialized.
- Polarity reversal requires use of mechanical means.
- High cost of very large units.

D. C. ELECTROMAGNETS

Advantages

- Field strength readily controlled by electrical means.
- May readily be completely de-energized.
- Depth of field readily adjusted.
- Design art is generally known.
- Easy reversibility of polarities.
- Low cost of very large units.

Disadvantages

- Requires source of rectified power.
- Limited by temperature considerations.
- Electrical failures may produce hazards.
- Frequently necessary to use slip rings or similar means to provide power connections.
- Repairs and burnouts due to aging and other causes.
- Limited resistance to shock, vibration, and similar mechanical forces.
- Power requirements lead to higher operating costs.
- Costly specialized circuits may be required for control.
- Limited for use to nonhazardous atmosphere locations or complex designs required for such locations.
- High cost of small units.

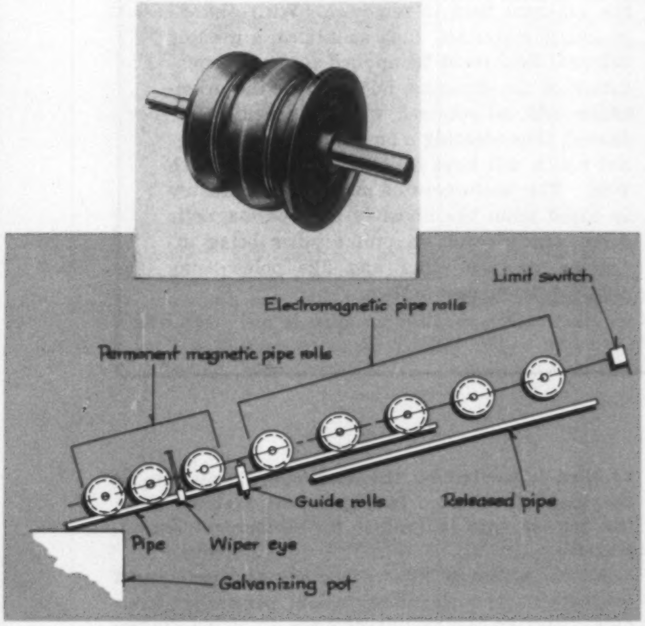


Fig. 8—Diagram of installation in which magnetic rolls, both permanent and electromagnetic, remove pipe from hot dip galvanizing bath. This illustrates the use of magnetic devices in areas involving high temperatures and corrosive atmospheres. Insert shows a typical permanent magnet double-contour roll.

of magnetic flux that the object will carry. Increasing the strength of the magnetic device beyond the saturation point of the object results in only slight further increase in force produced.

There is also a practical limit to the distance a magnetic field can be made to act. For example, applying an appreciable force to a 1 inch diameter steel ball from a distance of 5 feet by means of magnets is obviously in the realm of the impractical.

Cost frequently places limitations on magnets where a great many individual small items are to be handled and the operation is such as to require individual magnetic units.

The use of magnetic equipment occasionally poses problems due to the lack of selectivity on the part of the magnetic equipment between the object to be handled and other ferromagnetic objects in the area.

Residual magnetism remaining in the object being handled by magnetic means may also pose some problems, although these cases are usually limited to cases where the object being handled is a so-called hard ferromagnetic material. Demagnetizing devices may be required in such cases at some later stage of operations. The tendency of objects being handled by magnetic means to adhere to each other and metallic objects such as

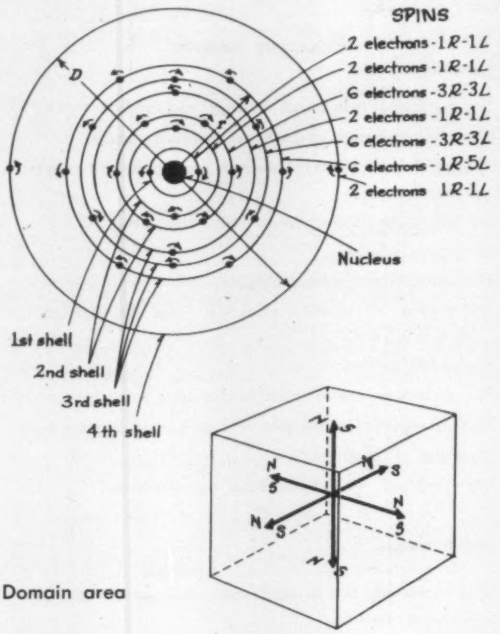
DOMAIN THEORY OF MAGNETISM

The present theory as to what makes a magnet is based upon the inner structure of an atom. The following explanation is concerned primarily with ferromagnetic materials, i.e., a class of substances or alloys that retain or temporarily manifest magnetic properties to a marked degree during or after they have been subjected to an applied magnetic field. Technically the term "ferromagnetic" is reserved for the strongly paramagnetic substances like iron, nickel, and cobalt. As used in practice, the words "magnetic material" are used synonymously with ferromagnetic material.

With reference to the diagram of an atom, the uncompensated, or off-balance planetary spin of the electrons in the third incomplete quantum shell, together with specific dimensional characteristics, creates a magnetic moment, or force. To create ferromagnetism, D/r must be 3 or more. This condition occurs in iron, cobalt, nickel, and rare-earth groups. Magnetic moments in neighboring atoms are held parallel by quantum mechanical forces which can be likened to the forces holding the sun, moon, stars, and earth in their relative positions.

The atoms possessing these magnetic characteristics are grouped into regions called domains. A domain is the smallest known permanent magnet, being composed of approximately 10^{15} atoms. In unmagnetized ferromagnetic materials the domains are oriented to conform to minimal energy requirements with the result that they neutralize each other. It is important to note, however, that the magnetic forces are present.

Application of an external magnetic field causes the domains to be aligned so that their magnetic moments are added to each other and to that of the applied field. With "soft" magnetic materials, such as iron, small external fields will cause great alignment, but because of the small restraining force only a little of the magnetism will be retained when the external field is removed. With "hard" magnetic materials, such as Alnico, a greater external field must be applied to cause orientation of the domains, but most of the orientation will be retained when the field is removed, thus creating a larger permanent magnet which will have one North and one South pole. The usefulness of magnets in industry is based upon the invisible lines of magnetic force which result in unlike poles being attracted to each other and like poles being repelled from each other.



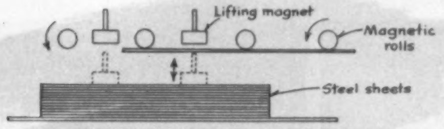
chips occasionally presents limitations to the use of magnets.

In some cases magnetic devices may produce problems since the field which produces the force cannot be seen. It should also be recognized that problems may be created due to magnetization of equipment such as scales or other complex mechanisms operating in the vicinity of the magnets. A distance of 12 inches or more can ordinarily be considered sufficient spacing from even the larger magnets.

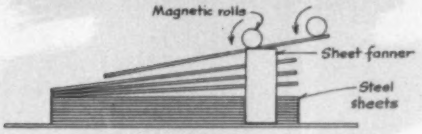
In very large units, particularly electromagnetic units, the rapidity of release of the object being handled is limited by the maximum decay rate of the magnetic field. In permanent magnet units the release rate is limited by mechanical considerations.

A comparison of electromagnets and permanent magnets tends to favor the use of permanent magnets, although obviously both have desirable characteristics. The remainder of this article is devoted to pictures and diagrams of the operations that can be performed with magnets. Illustrated are systems that indicate the tremendous versatility of magnetic devices which are applicable to some degree in nearly any automated system.

APPLICATIONS OF MAGNETIC HANDLING DEVICES

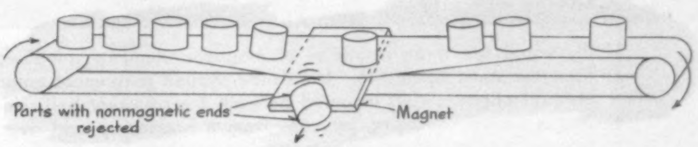

Lifting magnet
Magnetic rolls
Steel sheets

NORMALLY FOR SHEETS OVER 16 GAGE

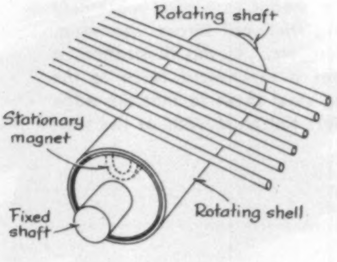

Magnetic rolls
Sheet fanner
Steel sheets

NORMALLY FOR SHEETS UNDER 16 GAGE

Depending on gage of sheet to be handled, lifting magnets or sheet fanners can be used in automatic feeding operation. In either case, sheet is separated from a stack and picked up by magnetic rollers to be conveyed to such equipment as slitters, coating machines, or punch presses.

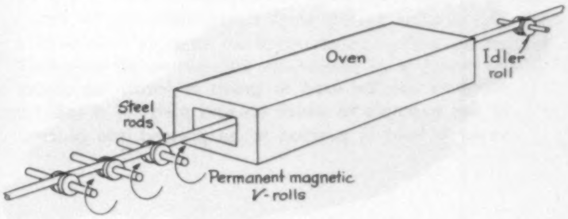

Parts with nonmagnetic ends rejected
Magnet

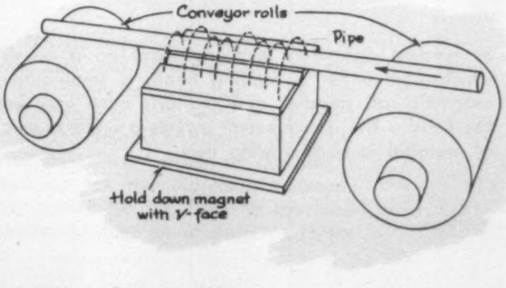
Separation application that involves cylinders with sides fabricated from nonmagnetic material and ends of magnetic material. Product is carried by a conveyor belt and tipped sideways over an installation of plate-type permanent magnets. Any cylinder that does not have magnetic ends inserted in the assembly operation will fall off conveyor. Magnetic forces hold acceptable products on conveyor.


Rotating shaft
Stationary magnet
Fixed shaft
Rotating shell

Magnetic device, for which a patent is pending, can be used to equally space lengths of tubing or pipe traveling in parallel paths. In illustration, permanent magnet induces like poles in pipes, causing them to repel each other and space themselves uniformly across the face of the shell.

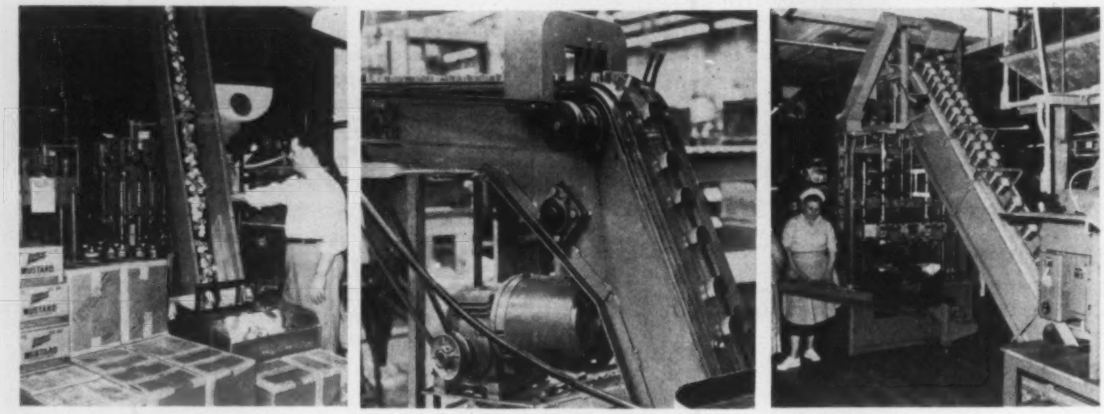
Conveying operations can be improved by the use of magnets. V-faced magnetic rolls are particularly suited to conveying rod, pipe, and tube items in production operations. Use of magnetic rolls can substantially reduce the number of motor driven rolls required for high speed operations.


Oven
Idler roll
Steel rods
Permanent magnetic V-rolls

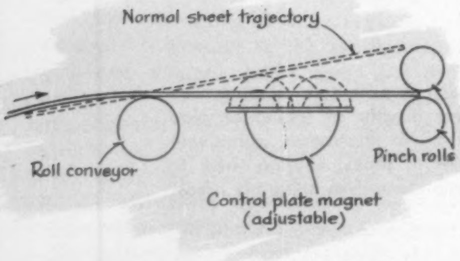

Conveyor rolls
Pipe
Hold down magnet with V-face

Hold-down magnets can prevent slippage of work moving on roller conveyors by increasing frictional forces. Illustrated is use of hold-down magnets in a pipe conveying installation. V-faced magnets also center lengths of pipe of various diameters as they are fed into a pipe coating process.

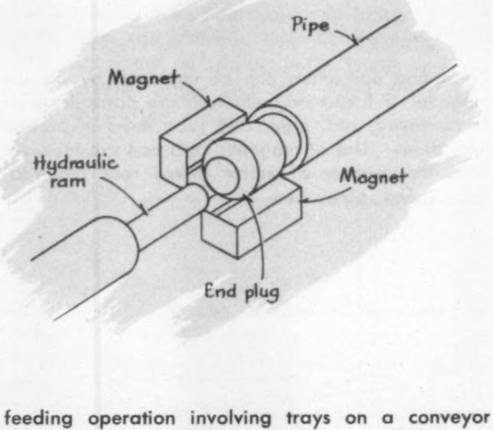
APPLICATIONS OF MAGNETIC HANDLING DEVICES



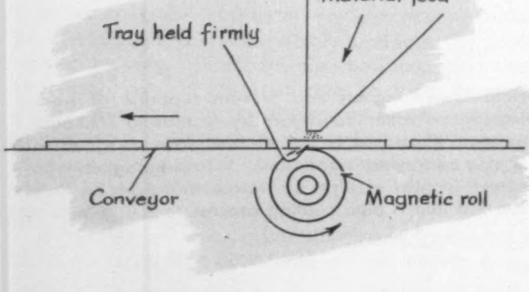
Illustrated are three examples of magnetic elements combined with belt conveyors to form magnetic conveyors. Horseshoe shaped permanent magnets are spaced along a pair of magnetic rails mounted beneath the conveyor belt. In one example, a 16-foot unit is shown conveying jar caps from a hopper up and over machinery into another hopper feeding an automatic capping machine. In middle photo, bearing parts are secured to conveyor belt in a spaced manner which prevents marring during movement. Third example shows how magnetic conveyor is used to elevate stainless steel tubs of candy to a point where the candy is emptied into packaging machinery.


Normal sheet trajectory
Roll conveyor
Pinch rolls
Control plate magnet
(adjustable)

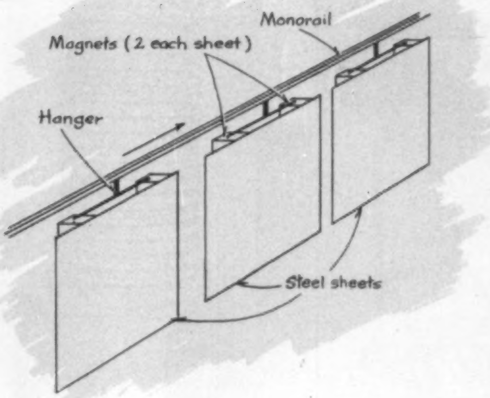
Magnets can be used as a means to control movement of an object by increasing frictional forces, centering, braking, controlling tension, etc. In this illustration, a plate type magnet applies a downward force to the leading edge of a moving steel sheet so that the edge of the sheet properly enters the pinch rolls at the start of an operation.


Pipe
Magnet
Hydraulic
ram
Magnet
End plug

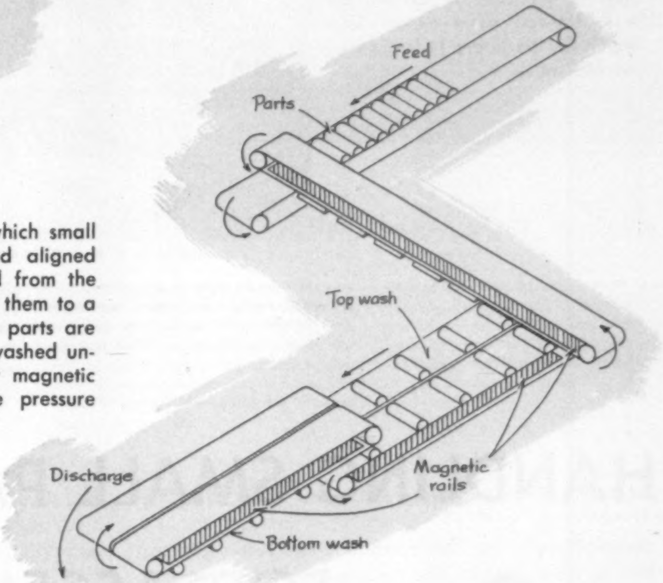
Magnets can be used to grasp or locate an object as in this example in which an end plug for a roller conveyor is held in position to be pressed into place.


Material feed
Tray held firmly
Conveyor
Magnetic roll

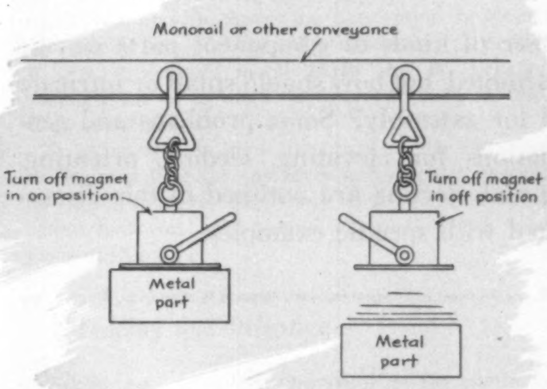
In feeding operation involving trays on a conveyor which pass under a feeding head, a small-diameter magnetic roll steadies and supports each tray under the head. The arrangement insures a uniform amount of material in each moving tray.


Monorail
Magnets (2 each sheet)
Hanger
Steel sheets

Small holding magnets have been used successfully in conveying 18 to 16 gage steel sheets, weighing approximately 20 lbs, through washing, drying, spraying, and baking operations.


Feed
Parts
Top wash
Magnetic rails
Discharge
Bottom wash

Magnetic rails are employed in system in which small metal parts are conveyed, transferred, and aligned in a continuous operation. Parts are lifted from the feed conveyor to a conveyor which transfers them to a series of parallel magnetic conveyors. The parts are held in position while the top surfaces are washed under pressure and then transferred to other magnetic conveyors where the bottom surfaces are pressure washed in a similar manner.


Monorail or other conveyance
Turn off magnet in on position
Turn off magnet in off position
Metal part
Metal part

A mechanically operated system enables a permanent magnet to be utilized as a lifting device similar to the better known application of electromagnets for this use. The permanent magnet installation is not subject to hazards which might result from power failure. As the illustration suggests, in a conveying system permanent magnets do not require connection to a power source.

To orient container tops, consisting of a ferrous disk and plastic spout, magnetic rail and pulley setup is used. The tops are fed from a chute onto a conveyor belt. If the desired orientation with metal disk down is not achieved, the part is picked up by the magnetic conveyor which carries the top back to the feed chute for another try at proper orientation.

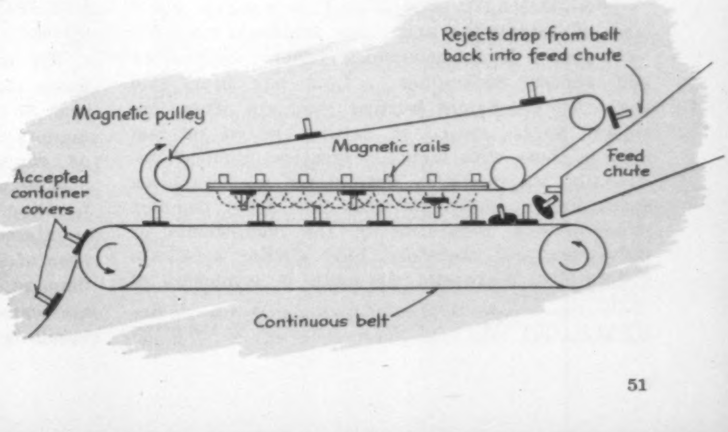
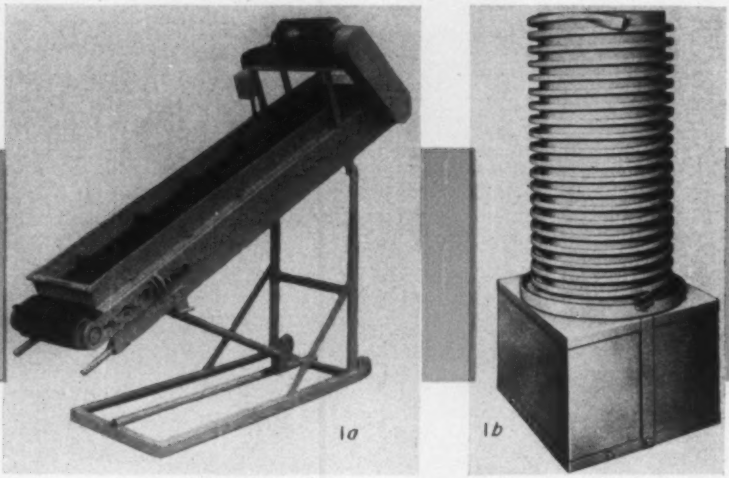

Rejects drop from belt back into feed chute
Magnetic pulley
Magnetic rails
Accepted container covers
Feed chute
Continuous belt

Fig. 1—Elevating equipment is often applied as an intermediate step in transferring parts from bulk storage to a feeder from which the parts are fed to an assembly machine.



Courtesy of New London Engineering Co.

Elevating conveyors are often used to supply parts to vibratory feeders or receive assemblies from a machine and transfer them away from the assembly area. Such units lose any orientation which may have been achieved.

Courtesy of Syntron Co.

Spiral vibratory units combine transfer and storage. They can be designed to feed parts up or down. When integrated into a parts handling system, they can maintain orientation or assist in achieving it.

HANDLING SMALL PARTS FOR ASSEMBLY

An infinite number of kinds of component parts can be automatically assembled, but how should small or intricate parts be handled for assembly? Some problems and general recommendations for elevating, feeding, orienting, escaping, placing and ejecting are outlined in this discussion and illustrated with specific examples.

By **E. GORDON READER,** Vice President and General Manager, Ferguson Machine Corp., St. Louis, Mo.

AUTOMATIC ASSEMBLY is a major phase of automation and much emphasis has been placed on its economics, general approaches and general techniques. Less has been said about the mechanics because they are often considered to be special in nature and of interest only to those with virtually identical applications. Actually, the problems encountered in assembling small and medium size parts have many common denominators, regardless of the components or industries, and, therefore, have similar solutions. Essentially, automatic assembly is composed of four parts; materials handling, feeding (including orienting), placing and ejecting.

The methods of handling and conveying parts from storage to the assembly machine are not new to any engineer associated with quantity manufacturing processes. In most cases tote trays or conveyors employing belts, rollers, screws, baskets or pneumatic means are used. These are familiar items, but there are two problems encountered in automatic assembly that may have been of little significance in the past. First, parts damage, however slight, must be prevented at all costs. Extreme care must be taken, in the handling of sheet metal, plastics and even rigid

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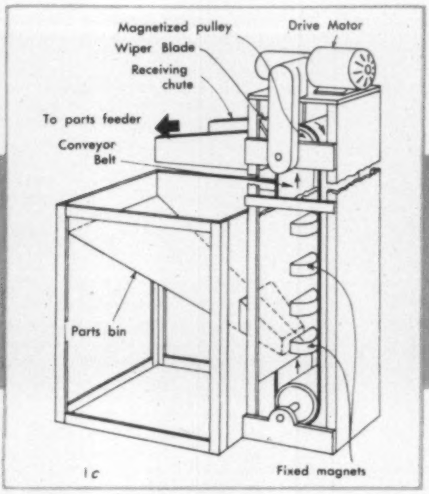
This article is based on a paper presented at the "Second Conference on Manufacturing Automation" cosponsored by AUTOMATION and Purdue University, October 1957.



Magnetic elevating conveyors employ a fabric belt conveyor backed up by permanent magnets. Ferrous parts can be lifted from a bulk storage unit to the top of the conveyor where they are wiped off into a chute. Such conveyors are virtually maintenance-free and permit vertical elevation without lugs. Some degree of orientation can be achieved with the aid of auxiliary devices.

Courtesy of Feedall Inc.

Cleated conveyors may be designed to select only those parts in a bin that are oriented to a prescribed degree. Orienting mechanisms are also possible at the top of the unit or in the chute, so that only oriented parts pass to the assembly machine while other parts are dropped back into the bin.

Courtesy of Cook & Chick Co.

This combination bucket elevator and rotating drum permits a larger number of orientations than that possible with an elevator alone. It also accomplishes the elevation of parts from a bulk storage container.

metal parts, to avoid crushing, bending, scratching, tangling, etc., because slight variations from standard may cause a jam in the assembly machine.

Secondly, parts usually must be elevated. Elevating conveyors are also not new, but special adaptations such as spiral vibratory units, cleated belts and bucket conveyors have been developed for use in conjunction with automatic assembly, *Fig.* 1. Ferrous metal parts can be elevated through use of a magnetic conveyor such as that shown in *Fig.* 1(*c*).

It is possible to take advantage of the elevation of the part in many instances and orient it during its upward travel *Fig.* 1(*c*) and 1(*d*). In most cases, however, only partial orientation can take place at this time.

▶ Feeding and Orienting

While there are often opportunities for eliminating the necessity for "unscrambling" small parts, it is normal to be faced with this problem in automatic assembly. The most commonly used solution is to employ automatic feeding and orienting devices to move parts from a reservoir to the point of placement in the machine. Such feeders, *Fig.* 2, can usually be designed to orient and select most of the parts and reject improperly oriented parts. In many cases, they can be designed to turn parts over or end for end, employing camming tracks, feelers, air blasts or other means to effect orientation by acting upon eccentric characteristics of the part.

In cases where automatic feeders cannot perform 100 per cent orientation, it is necessary to install supplementary orienting methods, usually mechanical in nature, between the feeding unit and the placing station. Mechanical or "in-the-track" orienting devices are almost always special purpose developments designed to accept parts in any two or more specific orientations, pass those correctly oriented and properly orient the balance. They are usually unsuited to accept completely scrambled parts.

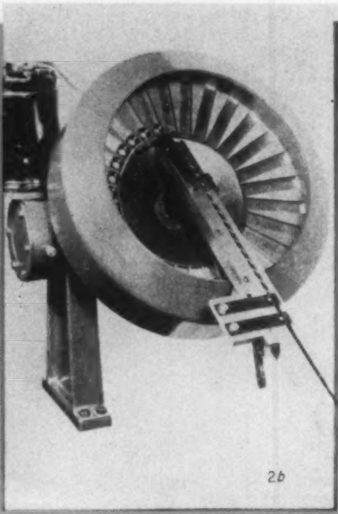
Virtually all parts have the same orientation at some phase of their manufacture. The retention of such orientation is a possibility that is often overlooked. Frequently it involves only the systematic gathering and transfer of parts after ejection from the last manufacturing operation. If such is not the case, it may be worth considering a revision of manufacturing methods to achieve orientation at this point. *Fig.* 2(*e*) shows the complex mechanism employed to orient a washer during feeding whose orientation might have been easily retained from the point of manufacture. *Fig.* 2(*f*) illustrates the ease of feeding and placing in the assembly machine a part that was oriented at the time of manufacture.

Many times it is feasible to manufacture a part on the assembly machine and thus minimize the problem of handling, *Fig.* 2(*g*). Fabric or rubber washers and gaskets are frequently blanked from strip stock immediately above the work holding fixture and placed directly into the assembly. Springs, which would otherwise tangle, can be made on winders incorporated into the placing mechanism.

After parts are under control, oriented and given a progressive movement toward the assembly point, the final operation prior to the actual assembly is the separating of parts into required

Courtesy of Syntron Co.

Vibratory feeders use a bowl with a spiral inclined track around its inside perimeter and an electromagnetic drive limited by springs to give torsional vibratory action to the bowl. The vibrations cause parts in the bowl to advance up the track.. Design of the track usually effects a high degree of orientation.



Courtesy of Detroit Power Screwdriver Co.

Rotary bowl units employ a rotating selector ring to select parts from the mass contained in the bowl and feed them to a chute. Orientation is accomplished by design of the selector ring so that only properly oriented parts are engaged. Gates or cams at the point of entry into the chute can also aid in orientation.

Orientation in the vibratory bowl feeder is achieved through the use of various cams, projections, cutaways, air blasts, etc. Most frequently they achieve orientation through selectivity, i.e., allowing parts that have been oriented by chance to pass on while rejecting improperly oriented parts. Successful bowl development depends mostly upon experience gained through previous applications or considerable trial and error.

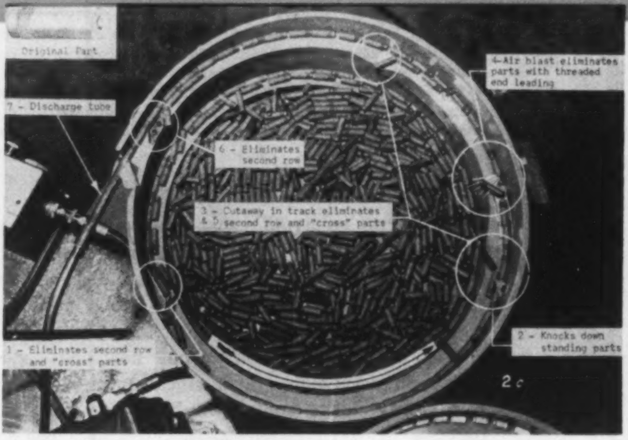

Original Part
7 - Discharge tube
4-Air blast eliminates parts with threaded end leading
6 - Eliminates second row
3 - Cutaway in track eliminates & 5 second row and "cross" parts
2 - Knocks down standing parts
1 - Eliminates second row and "cross" parts
2c

Fig. 2—Feeding and orienting means are frequently combined into a single piece of equipment which receives parts from parts elevators and other handling equipment or is manually loaded.

quantities for the actual assembly process. The mechanisms utilized for this purpose, called escapements, are frequently integrated with the orienting and feeding device or with the actual placing mechanism. Normally, the latter is preferable because it brings an abundant supply of parts as close as possible to the assembly into which the parts must go. Often the placing mechanism is used as the escapement as well and no separate mechanism is required.

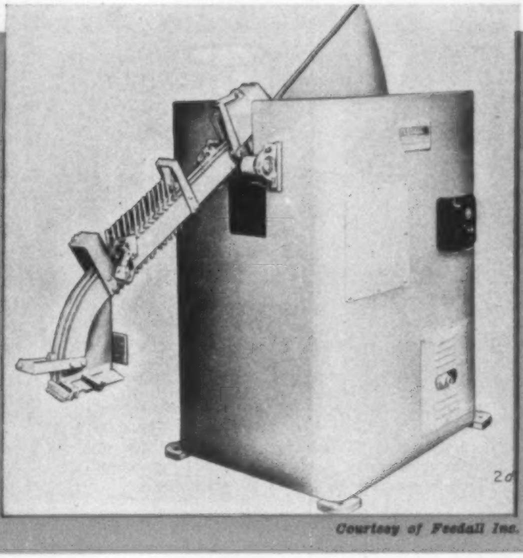
Escapement mechanisms seem to fall into four basic types—slide or ram; rotary, either continuous or indexing; rocker arm or ratchet type; and gate type. The slide or ram type escapement is one of the more commonly used mechanisms. Parts, moving in single file through tracks, can be easily removed in metered quantities in any direction perpendicular to their line of previous progress by a device as simple as an air cylinder actuated slide. In many cases the slide can actually place the part in the assembly, eliminating the need for a separate placing mechanism. Stacked parts are particularly easy to deliver with a slide type escapement, *Fig.* 2(*f*).

Rotary escapements are most frequently used for metering granular and liquid materials. In other applications they operate similarly to the slide in that the reciprocating slide is replaced by a dial having intermittent or continuous motion which removes parts from the stack. Specific examples are found in paper converting equipment such as cup manufacturing and envelope folding machines where paper blanks are removed from the bottom of a stack. Rotary escapements are seldom used in automatic assembly because their few advantages are counterbalanced by the difficulty in achieving the necessary rotary motion in pneumatic operations.

The ratchet or rocker arm type escapement is also easily adapted to selecting parts moving in tracks, but without changing the direction of parts movement. As shown in *Fig.* 3(*a*) it is feasible to combine rocker arm escapement and placing into one mechanism.

Gate type escapements, similar in principle to the rocker arm, have few applications in automatic assembly. They are most widely used with continuous conveyors where metering of parts is required.

Using more than one type of escapement at one station is unusual because separation is normally a single act not having several sequences (as in orientation, for example). It is common, however, to release a multiple of like parts at one station. Such feeding is done either by metering a specific quantity through a single escapement or



Courtesy of Feedall Inc.

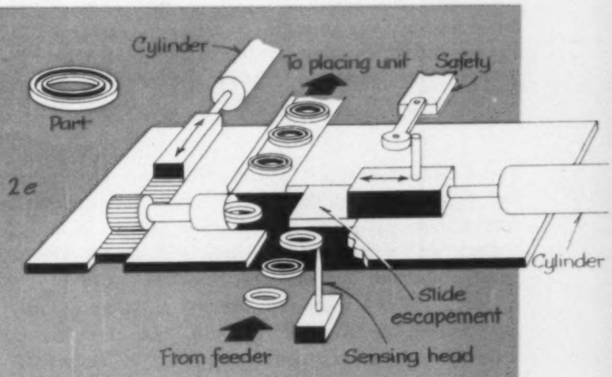
Oscillating blade feeders employ an oscillating blade that dips into a reservoir holding parts, selects and raises parts to a point where gravity feeds them down a chute. These feeders are well suited for handling, at high speeds, spherical or cylindrical parts that require little orientation.

by employing an individual escapement for each one of the multiple parts required, *Fig.* 3(*b*).

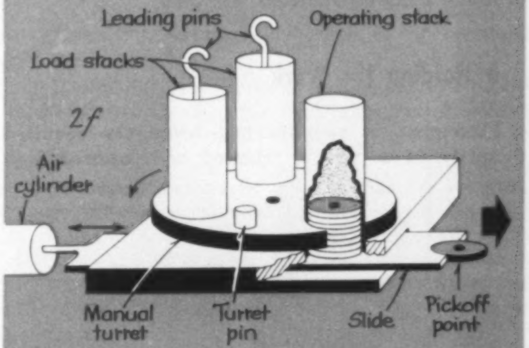
▶ Placing

The actual assembly, or parts placing, is the main element in automatic assembly operations and the consummation of all that has been done before. Placing mechanisms may be thought of as falling into three basic types: Push and guide, gravity fall, and pick and place. Push and guide placing units are widely used, *Fig.* 3(*a*). They offer two problems that must be overcome in design. First, the force of gravity must be counteracted by using spring backed detents, hinged jaws or other means to retain the part until the pusher can operate. Secondly, parts must be guided during pushing to minimize jams. One of the most satisfactory methods to achieve the desired result is to design the pusher to the configuration of the part, either internal or external, and thereby move the guide and part together. It is sometimes necessary to provide stationary guides. However, such guides must be designed with sufficient clearance to permit free movement of the part without allowing tilting, tipping, etc., to such an extent that jams result.

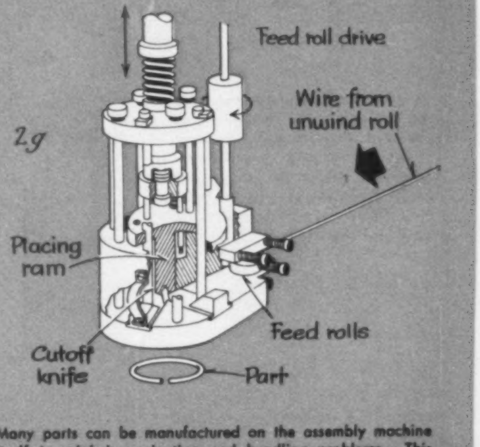
Gravity fall placing, *Fig.* 3(*c*), is the least expensive but the most difficult placing method to apply properly because parts placement depends upon gravity and friction forces and there can be little or no control over the rate of fall of the part. Successful use of gravity fall depends on the ability of the receptacle to retain the part, adequate clearance between the part and receptacle during fall and the stability of the part itself. Chutes



When opportunities to retain orientation during parts manufacture are overlooked, elaborate mechanisms are sometimes necessary. In this instance a washer with a groove in one side only is to be fed so that the groove is up, and the problem was solved with an "in the track" electrical sensing device and turnover mechanism. A pointed feeler determines the location of the groove and actuates the turnover unit if necessary.

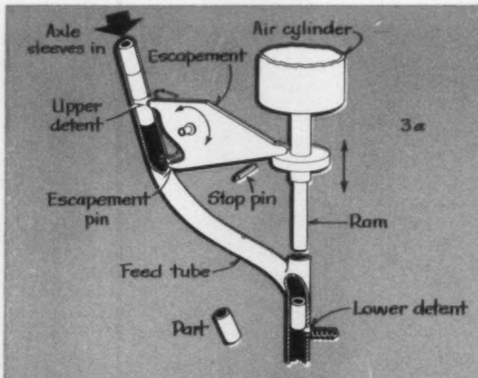


Feeding parts whose orientation is retained from earlier operations is relatively simple compared to reorienting them. In this example, metal discs lacquered on one side only were gathered on loading pins after a blanking operation and fed in oriented position into stacks in magazines. The device shown provides in-process storage in three magazines and an operating reserve above the slide type escapement. When the stack in one magazine is depleted, the turret is manually indexed to place a full magazine in feeding position.



Many parts can be manufactured on the assembly machine itself to minimize orienting and handling problems. This illustration shows a mechanism which forms a wire washer and places it in an assembly. Wire is fed from a spool, formed and then cut off and placed by the descending ram.

Fig. 3—The final operation prior to assembly is the separation of oriented parts into quantities required for an individual assembly. Such action is performed by devices called escapements which are frequently integral with the feeding or placing mechanism.



This unit combines a rocker arm escapement with a push and guide placing mechanism. The rocker arm releases one part for each cycle of the ram. The lower detent holds the part until the descending ram places the part in a work fixture.

and guides frequently make the use of the gravity fall principle feasible. It is applicable primarily to symmetrical parts.

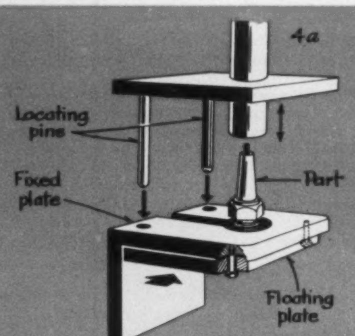
Pick and place mechanisms, *Fig.* 3(*d*), are the most elaborate but most positive means of placing a part. They employ a device such as a collet, jaw clamp or magnet to hold the part to the transferring mechanism, releasing it only after the part is deposited in the work holding fixture.

Combinations of the basic types are quite frequent, particularly that of the gravity fall with a push and guide mechanism to insure proper location of the part in the assembly. When a quantity of parts must be placed in the assembly at the same time, it is common to use a number of like placing mechanisms, *Fig.* 3(*b*).

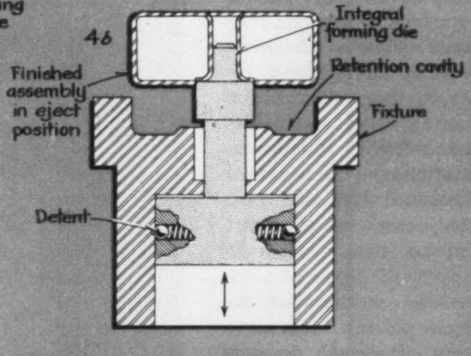
▶ Holding the Work

Placement is accomplished when the required quantity of a part is oriented and inserted in a work-holding fixture, or nest, on the machine. The prime functions of a work-holding fixture are to hold the partially assembled unit during transfer and to assist in the assembly and workstation operations. The objective of its design is to secure the parts firmly at the various stages of assembly while keeping the fixture as small as possible. Since transfer time is lost and nonproductive, the tooling engineer should provide for the smallest dimension of the assembly to be parallel to the direction of transfer. This allows a minimum movement between transfers and increases the productivity of the machine. Low cost per fixture will frequently allow the use of idle work fixtures to provide space for large tooling units without increasing transfer distances.

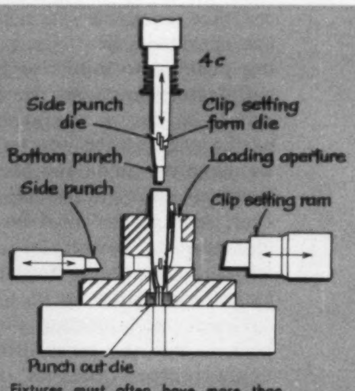
Accuracy requirements, in terms of the relationship of the partially completed assembly to the



It is sometimes necessary to have means other than the transfer mechanism itself to achieve the required accuracy in locating work-holding fixtures with respect to the tooling. One of the more suitable methods is to employ pins on the tooling to engage in a register hole on the fixture and locate a floating nest before the tooling comes into contact with the work.

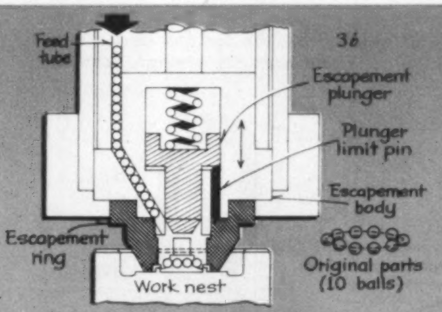


This nest has a single aperture or opening for entry into the nest and contains a forming die to shape a part as it is placed in the nest by a ram. It also retains loose bearing balls until the addition of another part to secure them. The center ram assumes three different positions, one for each of the operations described plus a raised ejection position.



Fixtures must often have more than one aperture to allow insertion of parts from several directions or permit work to be done. This nest, for assembling pen tops, has four apertures for insertion of parts, entry of tooling and removal of punched out material.

Fig. 4—Work-holding fixtures must be provided to hold the parts of an assembly in proper relationships while the assembly is being built up. The fixtures must also assist in the assembly.


3b
Feed tube
Escapement plunger
Plunger limit pin
Escapement body
Escapement ring
Original parts (10 balls)
Work nest

Feeding and placing a multiple of like parts at one station can be done either by metering the desired quantity through a single escapement or by employing an individual escapement for each part required. Illustrated is a combination feeding, escaping and placing mechanism. Ten tubes feed bearing balls from a common reservoir, and ten balls, one from each tube, are released and placed simultaneously by a single escapement and placement device.

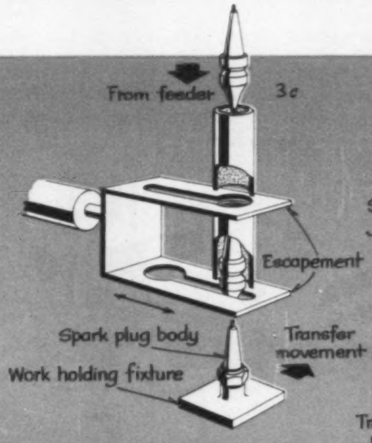
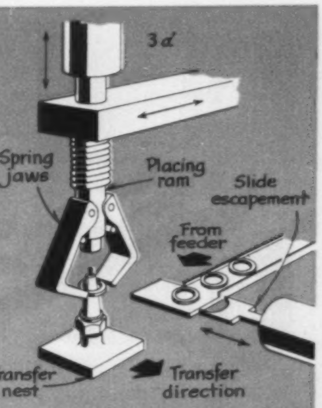

3c
From feeder
Escapement
Spark plug body
Transfer movement
Work holding fixture

Illustration of a slide or ram type escapement in a gravity fall placement mechanism. The part, a sparkplug insulator, requires external guides for proper placing.


3d
Spring jaws
Placing ram
Slide escapement
From feeder
Transfer nest
Transfer direction

Shown is a pick and place mechanism with a slide type escapement. Spring loaded jaws remove the part from the escapement and lower it into position in the assembly.

work stations, must be considered in the design of work-holding fixtures. In some cases, sufficient accuracy may be inherent in the transfer mechanism, as in some rotary indexing machines, but it is frequently necessary to provide auxiliary locating devices. Some designs utilize mechanisms to locate the carrier at a fixed point under the tooling while others employ a floating fixture and provide a means for the tooling itself to locate the fixture, and, therefore the assembly, accurately, *Fig.* 4(*a*). The latter method is more positive and usually most satisfactory, since there are fewer intermediate parts between the tool and the work wherein inaccuracy can build up.

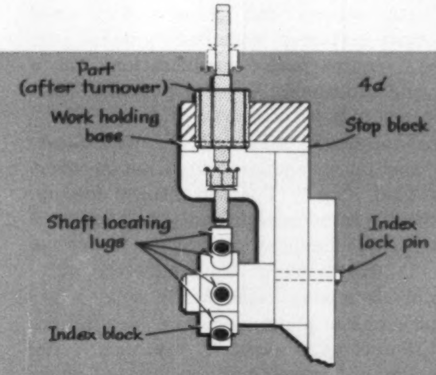
Work-holding fixtures can be grouped into four categories for discussion purposes:

1. Single aperture designs provide for the insertion of all parts from the same side with ejection accomplished by reversing the direction of insertion, *Fig.* 4(*b*).

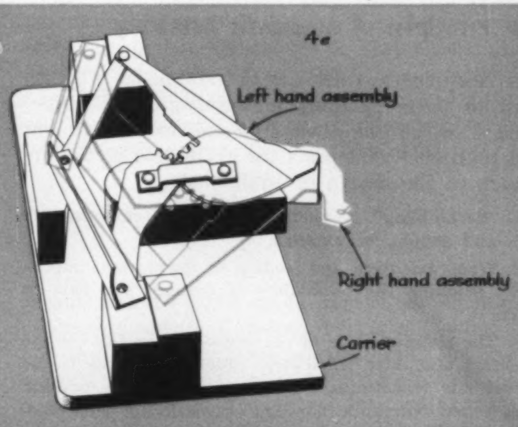
2. Multiple aperture fixtures are sometimes required to allow placing of parts from different directions, but more frequently are necessary to permit work to be done on parts, *Fig.* 4(*c*).

3. Transposing fixtures, usually trunnion mounted, expose different portions of the incompleted assembly to different workstations. Such fixtures are quite elaborate and it is often more feasible to design a station to remove the part from the fixture, turn it over or otherwise re-orient it and replace it in the fixture. The fixture, in such cases, must be designed to hold the part in two or more positions, *Fig.* 4(*d*).

4. Multiple product fixtures accommodate more than one type of product. Such fixtures are particularly desirable and possible when production volume is low on individual models but there is a similarity in parts

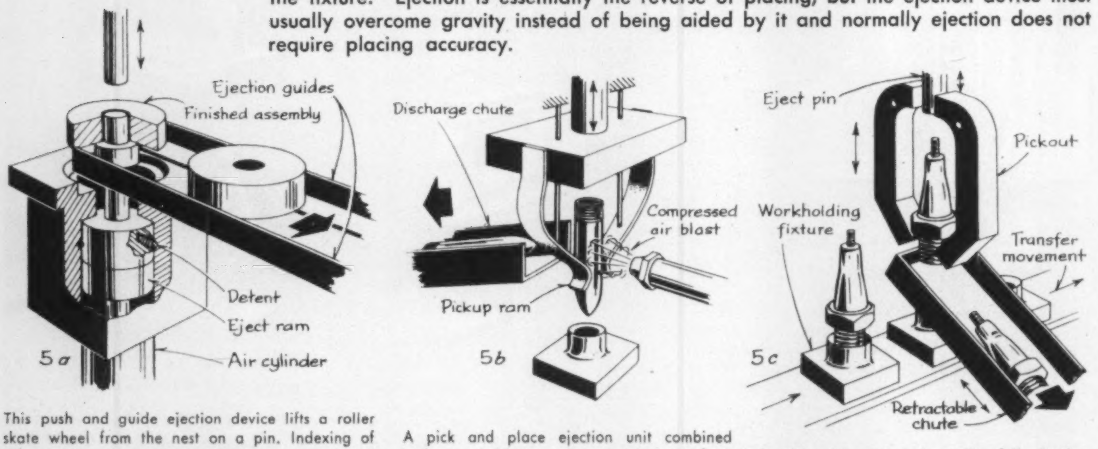

4d
Part (after turnover)
Work holding base
Stop block
Shaft locating lugs
Index lock pin
Index block

Elaborate means must sometimes be provided to expose various portions of an assembly at different stations. Trunnion mounted or other transposing fixtures may turn the nest and product, or the assembly may be removed from the fixture, turned and placed in the fixture again. The fixture shown is for the latter method and requires an external device, not shown, to reposition the work. The part is located vertically before turnover by lugs on the index block, which has lugs of various lengths for use with parts having different shaft lengths. After turnover the part is located axially and vertically by use of the stop block on the work-holding base.


4e
Left hand assembly
Right hand assembly
Carrier

Design of fixtures to hold more than one product may justify automatic assembly equipment not otherwise feasible. This fixture holds either a right or left hand automobile hood hinge. No adjustments in the fixture are required to change from the assembly of one to assembly of the other.

Fig. 5—When an assembly cycle has been completed the work must be ejected from the fixture. Ejection is essentially the reverse of placing, but the ejection device must usually overcome gravity instead of being aided by it and normally ejection does not require placing accuracy.



This push and guide ejection device lifts a roller skate wheel from the nest on a pin. Indexing of the machine causes the assembly to be engaged by stationary guides. During the next work cycle the pin is pushed out of the assembly and back into the nest by a ram and the assembly slides free on the guides.

A pick and place ejection unit combined with an air blast to remove a pen top from a nest is shown here. Picking is accomplished by a pair of prongs on the ram and the assembly is blown into a discharge chute as the prongs release it.

In this pick out and gravity fall ejection unit, spring loaded jaws pick a sparkplug from a fixture. Gravity fall deposits it in a retractable chute that moves under the assembly.

that permits the design of a versatile fixture suitable for two or more assemblies without modification of the fixtures, *Fig.* 4(*d*) and 4(*e*).

Ejection units are, essentially, placing mechanisms in reverse, and their designs fall into much the same categories. The gravity fall is accomplished by merely releasing the part. The push and guide type must usually overcome gravity, instead of being aided by it, *Fig.* 5(*a*). Pick and place mechanisms used for this purpose usually require no accuracy of placing, and frequently an air blast may be substituted for the placing action, *Fig.* 5(*b*). Pick out gravity fall combination is illustrated by *Fig.* 5(*c*) where a retractable chute is placed under the completed product after it has been picked out of the nest and before it is released.

▶ Principles of Automatic Assembly

A few general rules can be established with regard to parts handling in automatic assembly—none of which can always be said to be true, but which provide guideposts for evaluation of the approach to the design of equipment:

1. "Scrambling" of parts during parts manufacture can, and should, be avoided.

2. When orienting and feeding of parts seem impossible, examine the possibility of making the part in place.

3. The simplest type of placing—gravity fall—is the trickiest and most intricate. Pick and place is the surest and sometimes least expensive in the overall. This aspect warrants thorough evaluation in each placing mechanism.

4. Distances traveled by moving parts should be held at a minimum consistent with reasonable design. Amount of travel usually influences the production rate significantly and is frequently overlooked.

5. Product redesign and parts manufacturing processes specifically tooled for automatic assembly can effectively save capital investment in equipment and increase productivity of machines. Even minor changes may help appreciably.

Even though the techniques of automatic parts assembly are still developing, the principles are well founded and certain conclusions may be drawn, from experience to date and machinery development in general. First, the problems in parts handling, feeding, orienting, placing and ejection have many similarities in their solutions regardless of the components or industries.

Second, although transfer machines, feeders and small components have become more or less standardized, other standard major units have yet to be developed except for those few suitable for handling rivets, screws and other widely used parts. In most instances, so-called "general purpose" devices require major modifications for a specific use and often embody principles that limit their application to a certain type of usage.

Third, semiautomatic assembly, in which machines pace manual assemblers, must not be overlooked as a first step. The advantages are apparent in that it provides a gradual approach with time to develop mechanisms to replace individual operators. A single jump to completely automatic assembly is a very high hurdle.

Fourth, production plant personnel are all-important to the automatic assembly machine. The final integration, and some final development work, must invariably be accomplished in the production plant. Supervisors, maintenance personnel, and operating personnel with healthy attitudes and special training and experience in automatic assembly are very scarce, but a concerted effort must be made to develop these attributes in existing personnel by both the machine builder and the user.

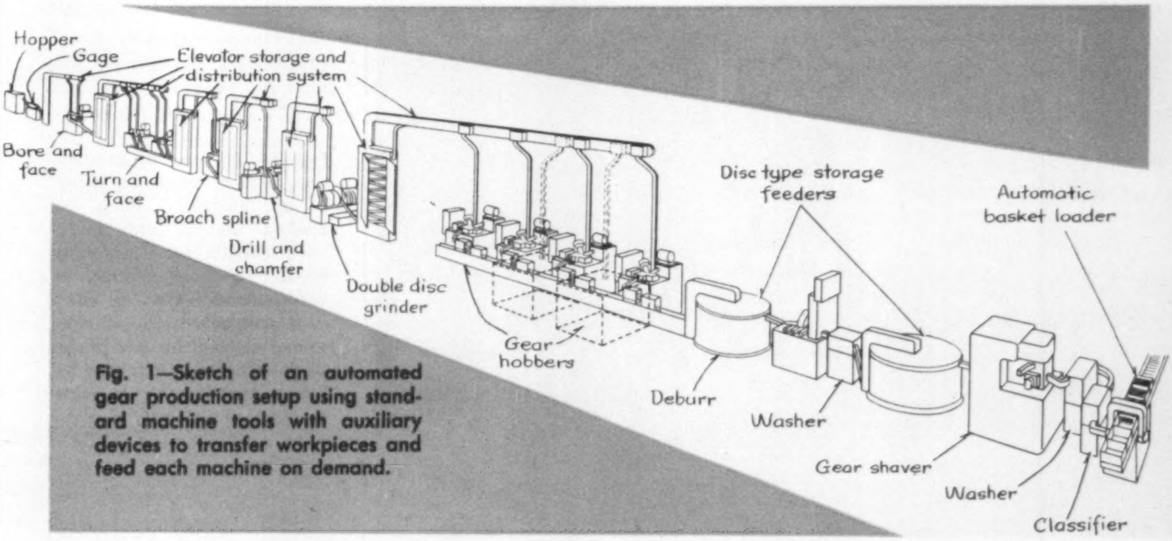

Hopper
Gage
Elevator storage and distribution system
Bore and face
Turn and face
Broach spline
Drill and chamfer
Double disc grinder
Gear hobbers
Disc type storage feeders
Automatic basket loader
Deburr
Washer
Gear shaver
Washer
Classifier

Fig. 1—Sketch of an automated gear production setup using standard machine tools with auxiliary devices to transfer workpieces and feed each machine on demand.

AUXILIARY HANDLING DEVICES

INTEGRATE STANDARD MACHINES

By FELIX ZAWASKI
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Gear-O-Mation Div.
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Basic to automation of machines—whether standard or specially designed—are properly controlled auxiliary devices for handling, storing, and distributing parts. This article discusses some types which can provide an answer to many production problems.

PRODUCTION of gears in the automotive field is an area in which automation has been economically applied using auxiliary devices with basic machine tools. Major elements in an actual gear production line are schematically indicated in *Fig.* 1. This is a fully integrated straight-line setup; it provides continuous production of gears from blank to finished part untouched by human hands. There are no costly centralized controls, no electronic complexes, no complicated servocircuits. Instead there are machine tools and auxiliary units such as transfer mechanisms, storage units, parts classifiers, checkers, etc.

▶ Why This Method?

What are we trying to attain through this type of automation? The quick answer is "to reduce production costs." Certainly, this is one factor, but not the only one. One of the other important reasons for automation is to get uniformly high quality. We want a quality level that cannot be achieved without mechanisms capable of doing a better job than people can do by hand. In some cases, products must be processed in volume, or speed, or at varied temperatures, or under chemical conditions which rule out human control.

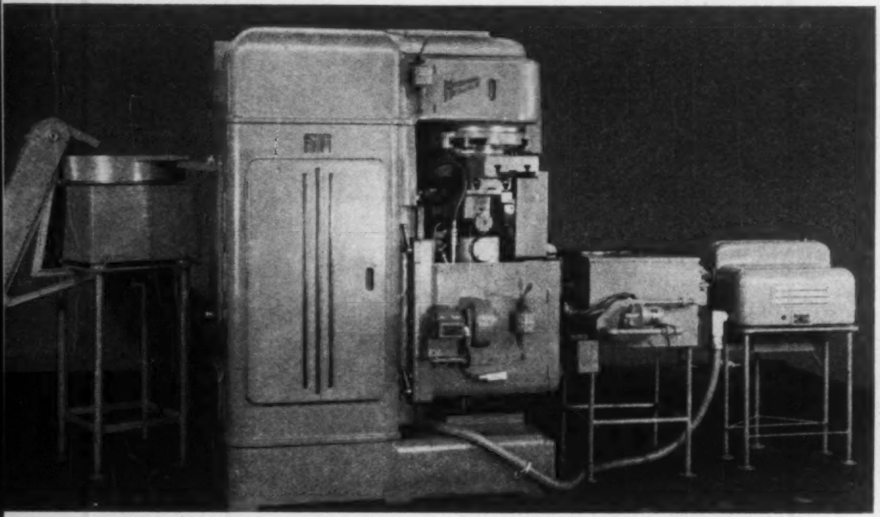


Fig. 2—One unit of production, such as might be found in an integrated setup including several such units, here includes an elevator, a feeder, a gear shaver, a washer, and a checker. Each such unit acts as a self-contained element for one phase of the process. Units may be linked together by a parts distribution system to form an automated line.

Production of automotive gears brings in several of these factors. But even without them, automation is essential to help offset rising labor costs.

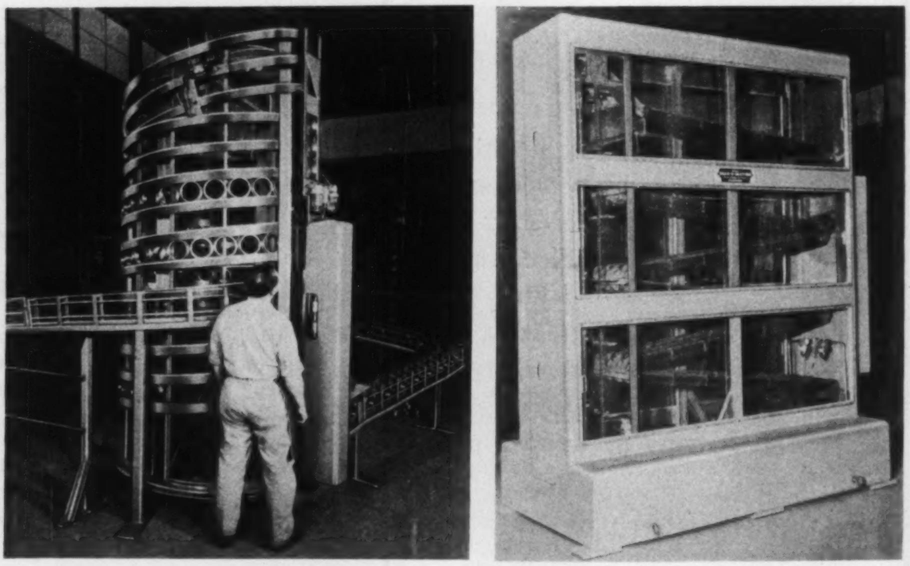
Automated machining lines can be broken down to production units of machines, washers, checkers, and controls. These production units, such as shown in *Fig.* 2, are integrated by means of parts transfer, storage, and distribution equipment. For optimum results the line should operate as close as possible to its maximum rate. This requires balanced machine outputs, e.g., because of its higher production rate only one shaver may be required to handle the outputs of six hobbing machines.

Generally speaking, the easiest transition to line automation is to use standard machines, modified with devices so that the product can move progressively through a complete sequence of machining and inspection operations. It is in the transition from the batch concept of manufacturing to the *continuous flow* concept that auxiliary devices have their best application.

Areas of Application

Production process stabilizing is an important consideration of any automated line. For this, we use storage units of various types, *Fig.* 3. The units, which become an integral part of a line, are used wherever necessary to insure continuity of production at full capacity. In operation, the storage units receive a floating and continuously moving bank of parts, store them, and feed them on demand to the next machine operation. They in-

Fig. 3—Shown are two types of storage units available to provide live storage for on-demand feeding to a machine. Both units require that the workpieces move freely by gravity down the storage tracks.



clude parts elevators, gravity-fed enclosed tracks, and escapement mechanisms. Designs in rotary or zig-zag types are such that the number of parts banked may be anywhere from several hundred to more than 5000. Number and size of the parts, of course, determine the size of the storage unit. The units are applicable only to parts that are cylindrical or spherical.

Using interlocked limit switches, machines on previous operations are automatically shut down when the storage units are filled to capacity. Subsequent machine operations continue to be demand fed. The fundamental principle of operation of these stabilizing units is to offer "mobilized storage," by which we mean the ability to have parts poised and ready to go one-at-a-time as needed.

Distribution of parts is handled by feeding systems made up with tracks, chutes, or conveyors which interconnect various operations. The feed system is loaded with blanks from a hopper which elevates and orients the part. Normally, the first line operation is a qualifying station, where probe-type gages divert under or oversize blanks from the system. The parts, after being gaged, are passed to an elevating device, raised, and redelivered to the distributing channels. These distributing channels vary widely as to type. Of late, we of Gear-O-Mation Div., in designing distribution systems, have virtually standardized on a fully-caged expansible track. It permits transfer of similar parts; speed can be easily controlled to avoid any damage to parts; and the tracks withstand considerable abuse. More importantly, they match easily with our machine drops, *Fig.* 4. These are devices which, by means of a zig-zag construction, reverse the direction of travel of the parts and slow their vertical descent speed. A wide range of escapement mechanisms for these tracks is available. Various types have been described in other articles (e.g., See—AUTOMATION, Feb. 1957).

Monitoring of parts is handled in-line and after a machining operation. With any precision machining operation like gear production, inspection is a necessity. Gears have to be checked for size, helix angle, runout and deformation. On high production gear lines it would be an economic impossibility to check all the parts manually. Checking is therefore done at high speed, automatically. Further, just as in the past when an operator shut down the machine if parts failed to pass inspection, the automatic testers must also be able to do the same. These testing mechanisms, working with precision master gears or sensitive probes, initiated the need for another piece of auxiliary equipment—parts washers. For proper functioning, testers must receive parts free of chips or dirt. Again, this has been done automatically and at high speed.

The cut parts first pass through an automatic washer, then to a classifier unit. The wash units are compact and fit right into the line. They effectively remove all chips and foreign matter from machined parts. After a solvent bath, multiple air jets assure a drip-free condition. Parts are carried through the washers by chain conveyor. Washing rates (usually about 1000 parts an hour) are adjustable to the application. In the classifier unit, oversize, undersize or correct size gears and their splines or keyways are gaged automatically using

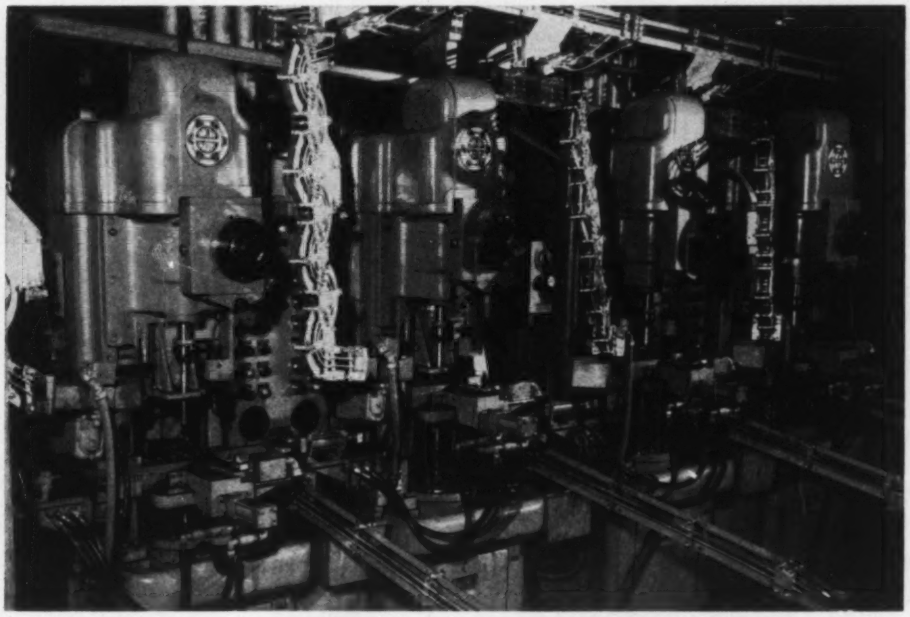


Fig. 4—Zig-zag drops, which require parts to reverse their direction of rotation as well as their direction of travel, feed gear blanks down to each machine in this battery of automatic honing machines. An overhead distribution system feeds parts on demand to the drop for each machine. A collection system takes the parts to a storage unit after they are released from the machine.

the pitch or root diameter as a reference base. This probe contact system measures 100 per cent of production. Parts with root or pitch diameters within specified tolerances continue through the classifier to the caged track for the next operation. Wrong-size parts are automatically shunted aside for salvage or scrap.

Special operations, like heat treating of parts, and storage at the end of an automated line may require skewer loaders or automatic basket loaders, *Fig.* 5. Where loading of parts on a skewer or rod is required, a high speed skewer loader can be used. This equipment positions a number of parts so that the operator can easily pass a skewer through the center-bored holes in the parts and lift them onto a cart or rack. They may then be taken to heat treat after which they may be fed back into the integrated automated line. Basketing of parts is facilitated by another automatic loader. As parts leave the last operation in the line they are fed through tracks to the loader. The rolling parts are guided and tipped by a curved channel fixture and held at the bottom end. Release into the baskets is actuated by automatic indexing of the conveyor-carried baskets. Parts are dropped on upright retaining prongs in the baskets, a row at a time. Loading rates up to 3000 pieces per hour are obtained with this equipment.

The components on the line have to be fed with parts properly positioned. For this we use hoppers, tracks, silhouette devices, chutes, and many types of conveyors. All of these must be controlled (usually by limit switches, proximity switches, or photoelectric cells) so that parts are released as required by the succeeding operation. Unit feeders are interlocked to a control point where feeding rates can be varied as desired.

In describing auxiliary control devices, it must be remembered that one of their primary functions is to serve as programming devices. They initiate a sequence of prescribed machine operations. They do not correct machines in terms of output, for few machines are truly self-correcting. Feedback is not a part of these devices—it is not really necessary to automatic production. Feedback control assumes machines need correcting. Many machines, however, do not need integrated correction, so feedback would be valueless in most of these units.

These then are the auxiliary devices of automation. There are other types for special application but the units described offer the broadest range of use. They are functionally designed to extend the scope of automation, working with one machine or twenty, in small or large shops. Their use is not restricted to machining lines—they can also be applied to certain assembly operations.

Fundamentally, their use offers the advantage of positive parts control. There is no deterioration of parts by marring or scoring; no starving of stations. They offer automation by integration of standard machine tools, and such automation can be attained economically with presently available equipment.

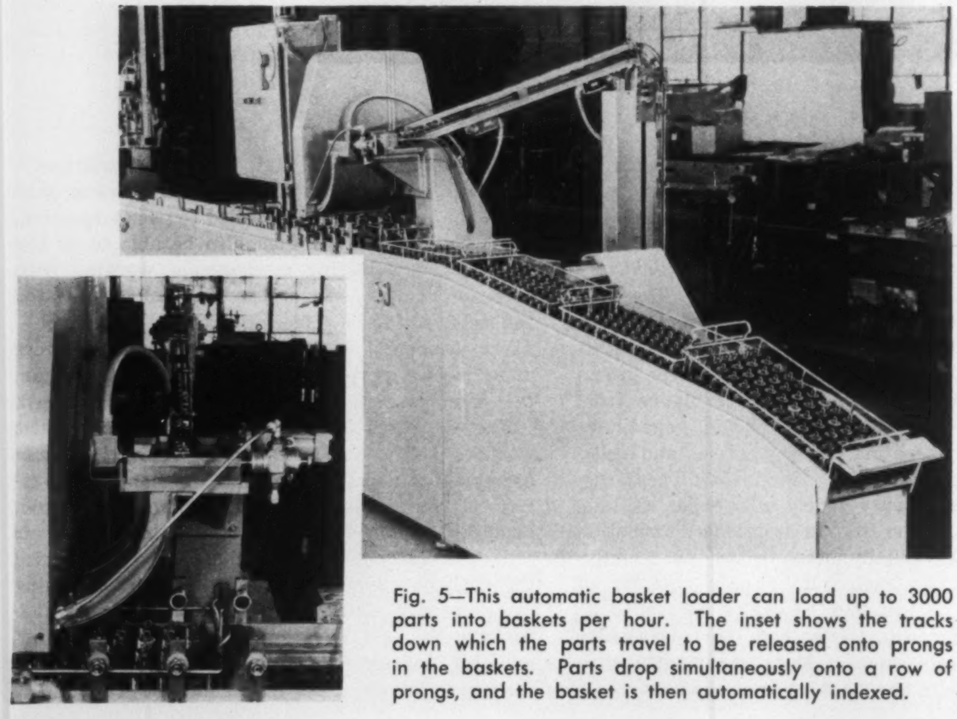
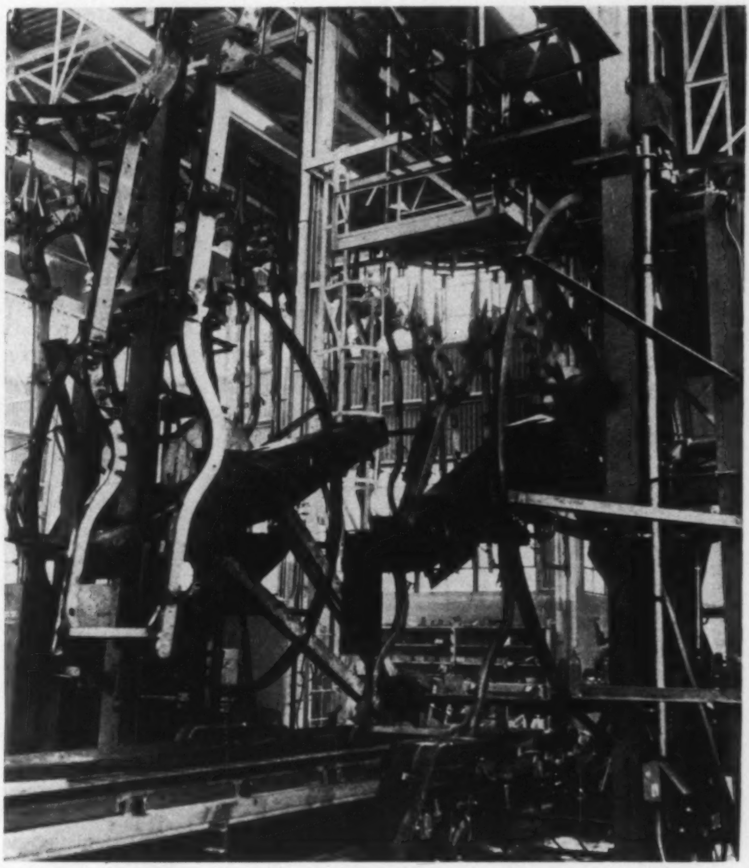


Fig. 5—This automatic basket loader can load up to 3000 parts into baskets per hour. The inset shows the tracks down which the parts travel to be released onto prongs in the baskets. Parts drop simultaneously onto a row of prongs, and the basket is then automatically indexed.

Fig. 1—View of automatic transfer mechanism used to pick up automobile frames from slat conveyor in left foreground and hold them until they are carried away by hooks on overhead chain conveyor.



AUTOMATICALLY HANDLING PARTS IN PROCESS

By JERVIS C. WEBB
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Jervis B. Webb Co.
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Bulky or oddly shaped parts can create serious handling problems, but such parts can be effectively handled through the steps of a process. Here basic factors are discussed for design of systems to handle difficult parts. Some typical cases and their solutions are covered.

SINCE WE in our company are primarily interested in the various methods of tying a number of conveyors into an integral unit, and of tying the conveyors into the various machine tools and process machines by mechanical transfers, that is the particular phase of automation I will attempt to cover.

Handling Factors

Specialized equipment for transfer points between conveyors and machines is nearly always used. However, certain types of conveyors which

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have transfer devices built in (for example, the power and free conveyor) are also used for these applications. Using conveyors for transport of materials, together with proper transfer devices, we find that two major methods answer the requirements: (1) Precision method; and (2) The method by which conveyors merely deliver the materials to an area. Then auxiliary equipment, which is part of the machines themselves, properly locates and feeds the material into the machines. Sometimes manual transferring is used until volume and costs justify automatic transfer. Because of time limitations and the scope of the subject, I will discuss only the precision method, although some of the examples mentioned will show both.

The precision method includes custom made conveyors and usually has bar transfers, walking beams, or fixture type conveyors, interlocked with transfer mechanisms of machine tools. This method requires that materials or parts conveyed be held in complete control during motion (no gravity motion is used). The precision method lends itself mostly to in-line machine operations.

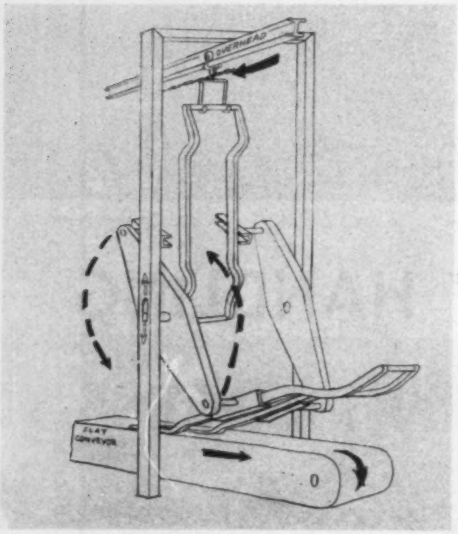


Fig. 2—Sketch illustrates operation of the automatic loader which transfers automobile frames from a horizontal position on a slat conveyor to a vertical position on an overhead conveyor.

When planning extensive automation lines close co-ordination between designers and manufacturers of various components is absolutely necessary. Machine tool manufacturers and material handling manufacturers, as well as manufacturers of auxiliary equipment, like washers, dip machines, gaging instruments, etc., must co-operate to provide the best possible system. This is especially true where it involves transfer mechanisms within the machines that have to co-ordinate with transfer mechanisms between machines. This close co-ordination will prevent interferences, loss of cycle time and complicated mechanisms. It also assures most economical interlocking, smooth transfers, and the ability of the equipment to handle the required capacity.

All transfer mechanisms must present the material in a properly located manner to the machine tool or any auxiliary machinery. This calls for manipulating mechanisms within the transfer, since orientation changes from machine to machine. Manipulation may consist of a number of different components within the transferring mechanism. It may contain rollover devices, turnaround devices, or slow motion devices along the transfer mechanism where minor auxiliary assemblies can be made while the product is in motion. Also, a mechanism often has to be included to clean the product of chips or other material before presenting it to the next machine.

If orientation between two machines requires a number of various motions, it may be necessary to divide this manipulator into several units to prevent complication of the manipulator and also prevent excessive production time. By dividing a complicated unit into several simple units, each having only one motion, the end result is accomplished in a short time. Also, to obtain less costly equipment, standardizing to a degree on various motions will help. Another important feature to be considered in designing transfer mechanisms

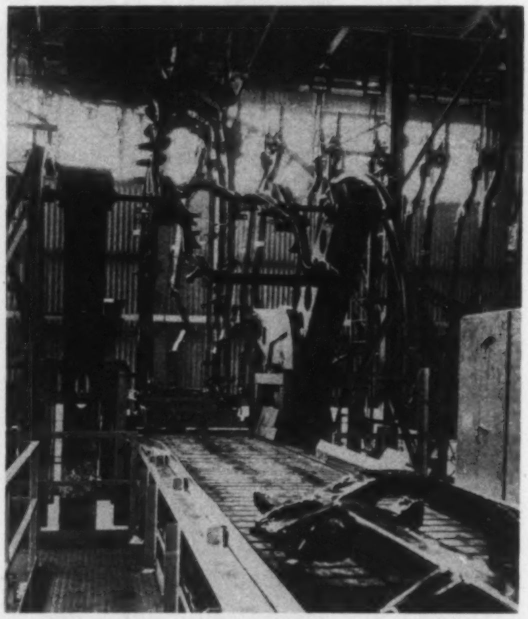


Fig. 3—The triple-arm device in the center of this picture unloads automobile frames from an overhead conveyor and lays them down on a slat conveyor.

is the matter of speeds encountered. This involves consideration of acceleration, deceleration, and prevention of overtravel. The latter can become quite a problem when exact positioning is required, and may in a lot of cases call for the transfer mechanism to hold the product at two points, one for pushing and one for holding it back to prevent overtravel.

It is an established fact that in many new applications definite attention has been given to the product being manufactured to facilitate easier handling through the various transfers and machines. Proper surfaces and locating projections are provided which can be used to move the product on rails or give proper means of locating or manipulating the product. This consideration often incorporates elimination of awkward projections on the product which may make clearance problems very difficult, as well as necessitate complicated transfer rails and slides. However, it does not mean that standardized detail assemblies cannot be incorporated. It might be well to mention here that it is often possible to design the fixture with sufficient flexibility to permit its continued use after a model change. Many times, too, in the precision method it is economical to design a product so that it can be handled easier, but this is not always necessary. Sometimes, by so doing, it aids both the product and the economical manufacture of it.

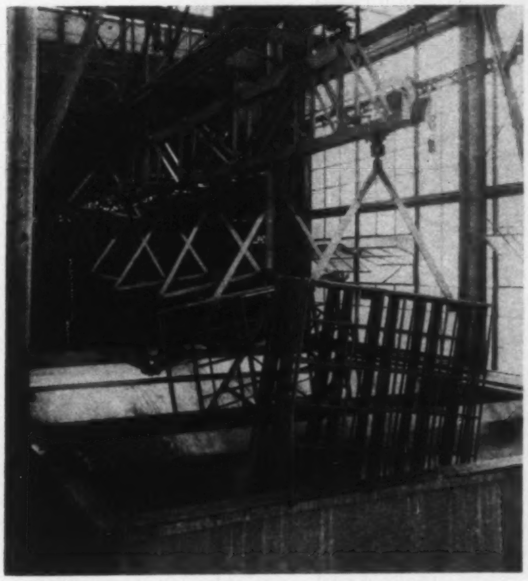


Fig. 4—Steel window frames hung on carriers can be dipped in a series of five tanks by use of the 5-stage walking beam elevator shown here.

Product limitations frequently govern the selection of transfer mechanisms. For example, when surface damage is critical, sliding must be avoided. Walking beam type transfers or conveyors which carry the part are required. Some products of very irregular shape may require carrying fixtures on either transfer mechanisms or conveyors. When these parts must be located very accurately and do not lend themselves to conventional material handling equipment, they will require pallet type fixtures to hold the product. These fixtures then become the part that is being handled by the transfers and conveyors. In these instances, the fixtures would be provided with all necessary locating surfaces to properly spot them within the machine tools.

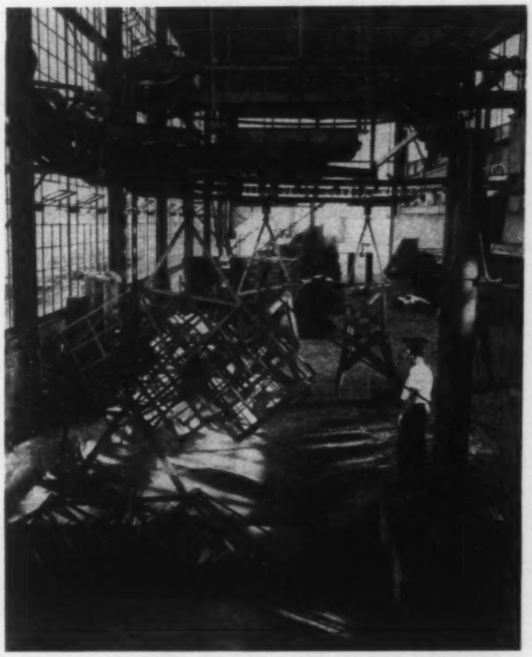


Fig. 5—A minimum amount of space is used for painting by dipping loaded racks of window frames vertically into a paint vat.

Corollaries to good use of the precision method include systematic preventive maintenance and systematic tool changing. It is also usually desirable with automated in-line installations to provide at critical points so-called banking stations that permit certain machines to operate even though a preceding machine is down. In other words, an entire line should be set up for higher capacity than the actual required production. Thus, banking stations can be filled with parts during ideal running conditions to allow production to continue for some time if one of the machines is shut down for any reason.

▸ Drive Mediums

The driving of transfers and conveyors may be accomplished through pneumatic, hydraulic, or electric power. The selection of the drive medium depends on a number of conditions. One of them is speed. If the product is light and has to be moved at relatively high speed and does not have high inertia, pneumatic power is adequate. If loads are heavy, speed not too high, and accuracy of motion is required, hydraulic power is an ideal method since acceleration and deceleration can be controlled quite accurately, while speed can be held to reasonably accurate limits. Frequency of cycle will in a number of applications dictate the type of power required. Again, for light loads, air may be used; but if relatively fast cycles are to be maintained and high surface speeds are required, hydraulic power or electric drives may be necessary. If absolute accuracy of timing is required, the selection of electric power and gear trains nearly always results.

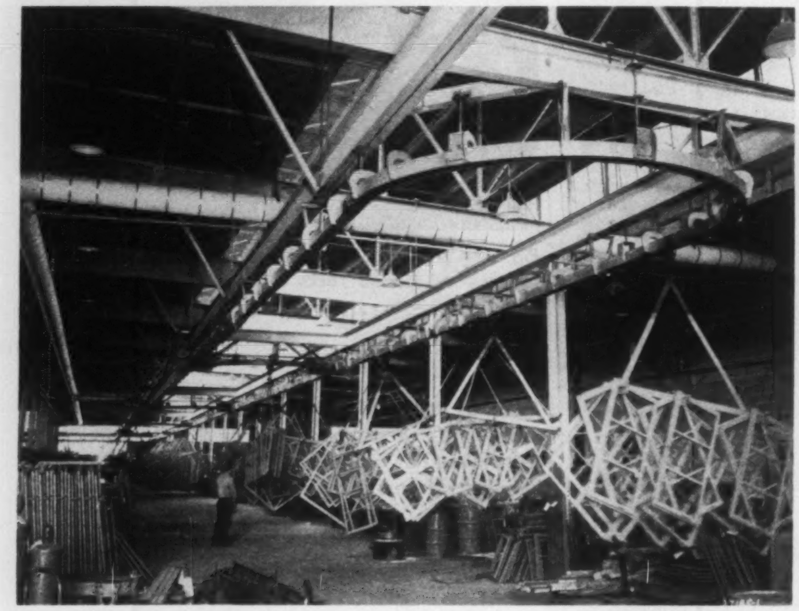


Fig. 6—When the painted window frames have been dried, the carriers holding them are pushed onto combination storage and shipping lines.

It is important when designing a complete installation that all transfers, or even components of transfers, be powered separately. This method lends itself readily to standardization, and makes it easier to locate trouble. It also gives the maintenance crew a better chance for repairs since it is not necessary to disassemble large machinery. In addition, it permits a production plant to have desired spare units which can be put into service by merely replacing the defective unit. These separate drive units also assure adequate power to perform individual functions, and it is also easier to keep the required cycle timing, especially if air or hydraulic power is used.

▸ Handling Automobile Frames

So much for the preliminaries; now for some examples. An example of automatic handling of bulky parts is that of automobile frames. In one system, complete automobile frames are produced on automatic conveyors and transfers. After the side rails are welded together, they are automatically moved onto assembly or welding conveyors provided with fixtures to hold the side frames. At different stages, conveyors bring cross members to the main conveyor, where operators assemble and weld them to the side rails. The main assembly conveyor has fixtures for the frames spaced at regular intervals. It follows a start-and-stop cycle, so that the frames remain motionless while the operators perform their work. On definite time cycles, a bell sounds, warning the workers, and the conveyor moves one fixture spacing at rapid speed. This conveyor also incorporates an automatic turnover device at two points to facilitate production. The turnover device grabs the frame, lifts it from the fixture, rotates it 180 degrees, then deposits it onto the fixture conveyor again.

At the end of the main assembly conveyor, the frames are transferred to a cross-type chain transfer which moves them through a checking station. At this station, they are tested for alignment, and if necessary, straightened to come within prescribed limits. Beyond this testing station, frames are automatically discharged onto a slat conveyor, which moves them lengthwise and 90 degrees to the travel of the cross-transfer conveyor. This slat conveyor moves the frames automatically to a position where an automatic loader places them on the hooks of an overhead chain conveyor, *Fig.* 1. The overhead conveyor carries the frames through washing, painting, and drying, and finally to the shipping building. In the shipping building, the frames are automatically unloaded onto a slat conveyor by a triple-arm rotating device having

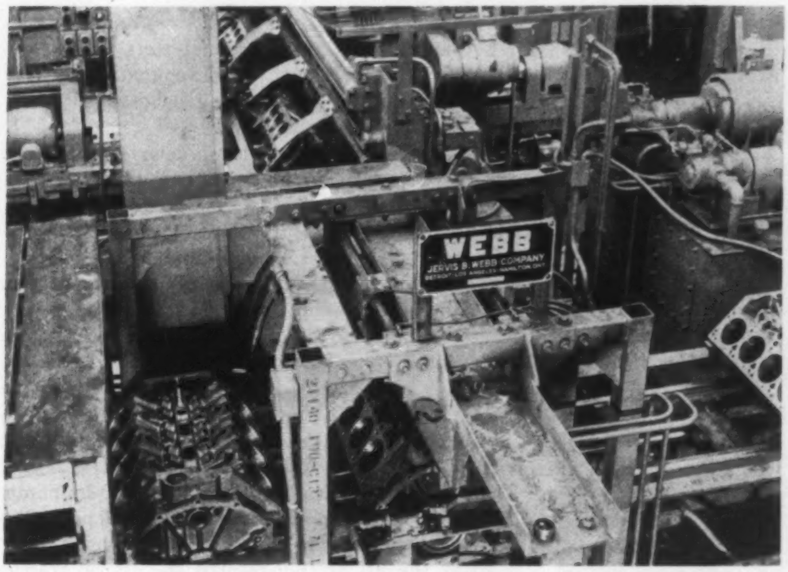


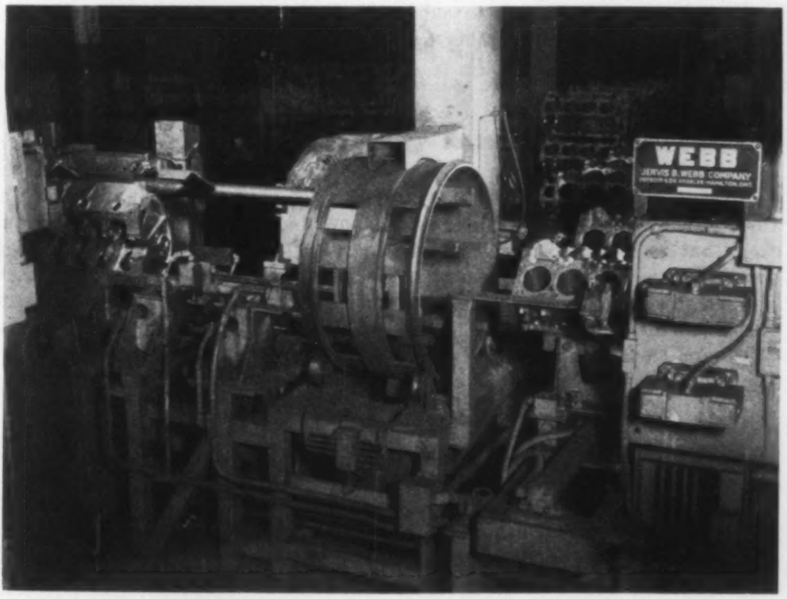
Fig. 7—In this automated engine block machining line, partially shown, blocks are automatically fed on demand into three parallel boring machines.

clamps on each arm which manipulate the frames from a vertical to a horizontal position while making the transfer. The slat conveyor moves the frames to an automatic device which stacks them onto a small conveyor having several stations. They are stacked to the right height, and a crane picks up the stacked frames and deposits them on railroad cars for shipment.

A short description of the frame loader may be in order at this point. This unit, *Fig.* 2, consists of a double-arm, rotating device having clamps on each arm. As soon as the slat conveyor has brought a frame into position, the clamps engage it, and immediately the arms start to rotate, carrying the frame to a position just prior to dropping it on the overhead conveyor hook. The control of this automatic loader is such that it will never bring a frame to the unloading position unless a hook of the overhead conveyor is in the proper position. A control is connected to the overhead conveyor to signal the unloader the position of the hooks at any time. The speed of the unloader is controlled so that it will make the required cycle; however, if for some reason the unloader is late, it will stop at a safety point and then it will be necessary to complete the loading of this particular frame by manual control.

The unloader, *Fig.* 3, works in very much the same manner except, as mentioned before, it is a triple-arm rotating device. It is controlled to clamp a frame

Fig. 8—Blocks are turned 90 degrees by a rollover device in each boring machine line.



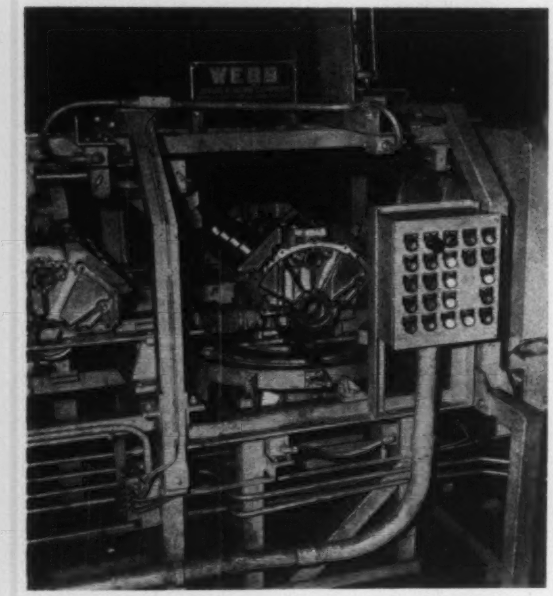


Fig. 9—Before additional machining operations, blocks are loaded on turntables such as the one shown and turned 90 degrees horizontally.

as soon as it comes in position or in line with the unloader arm. As soon as a frame is clamped, the unloader rotates and by special gearing, rotates the frame during the unloading cycle from a vertical to a horizontal position. Thus, when it approaches the slat conveyor, it will only have to release the clamps, and the frame is ready to be moved by the slat conveyor to the stacking unit.

The stacking unit is a double-unloading mechanism depositing one frame first to one side and then to the other side. The unloading unit is equipped with an automatic hook which takes hold of the frame in very much the same manner as the automatic hook used in handling completed motors when transferring them to balancing machines.

▶ Handling Window Frames

Another example of handling bulky parts through various processes is one of our power and free conveyor systems in a plant making steel window frames. The frames are of various sizes and weights, and are about as awkward a product to handle through processing as one can imagine. They are loaded onto racks on a free section of the conveyor, and the track is so graded that a light push carries the loaded carriers down to a point where the power chain engages the free trolley, and pushes it to ceiling height on its way to the Bonderizing operation.

The problem of getting loads down from ceiling height without using a lot of valuable space is accomplished by a 5-stage walking beam elevator, which operates vertically, *Fig.* 4. The power conveyor deposits hanger loads up to 1000 pounds onto the elevator, an operator presses a push button, and the load is lowered into a series of dip tanks. At the expiration of the preset time, the beam comes back up, aligning itself with the free track, stops are automatically removed, and the load proceeds to painting vats. Here again minimum amount of space is consumed by lowering the loaded racks vertically into the paint vats, *Fig.* 5. The lift is hydraulically operated by a 30-hp pump. The combination of Bonderite unit and paint dip has a maximum rate of 36 loads per hour.

After the lift section returns the dipped frames to the conveyor track, the loads are picked up by the power line and conveyed to the paint drying oven. After drying, the frames are pushed onto combination storage and shipping free lines, *Fig.* 6, from which they can be easily pushed by hand to the motor truck or railroad shipping docks. This arrangement gives the manufacturer a very considerable mobile storage, and the system as a whole gives him a very economical and efficient layout.

▶ Handling Engine Blocks

A final example is an installation in a plant of one of the "Big Three" automobile manufacturers. Here engine blocks are automatically fed on demand into three parallel boring machines from a common line, *Fig.* 7. At each boring machine station, the engine block is transferred from the feed line into a rollover unit, *Fig.* 8, which turns the block 90 degrees prior to machining. After machining, the blocks from the three boring machines are fed into a common unloading line.

For additional machining operations, a double gravity dog type transfer bar automatically loads blocks onto a turntable, *Fig.* 9. After the transfer bar retracts sufficiently, the turntable will revolve, changing the direction of travel 90 degrees, or at right angles to the feed line. Upon completion of the turn, a pusher bar automatically loads the block into a 180 degree rollover unit to position the block for further machining from the bottom. Thereafter it is automatically ejected into a welch plug inserting machine, completing our segment of the handling.

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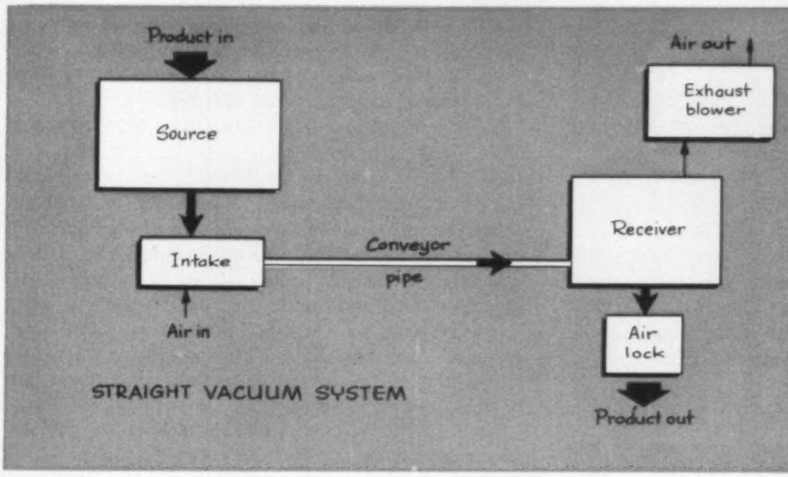


Fig. 1 — Block diagram of straight vacuum system of pneumatic handling shows relationship of equipment components. At point of intake, material enters air stream going into conveyor pipe. Receiver reduces velocity of air so that material falls out. Exhaust blower creates partial vacuum that causes flow of air to receiver. Air lock permits material to get out without letting air in at this point.

PNEUMATIC HANDLING SYSTEMS

SOLVE PROBLEMS OF MOVING BULK MATERIAL

Production processes that consume dry solid materials in pelletized, granulated or pulverized state have inherent handling problems. The author describes three basic types of pneumatic handling systems and how they provide automated solutions to these problems.

By L. G. WELLER, R.P.E., Manager, Airveyor Sales Div., Fuller Co., Catasauqua, Pa.

SUPPLYING MATERIALS to production processes is one of the problems of concern to those who devise, install, and operate automated production facilities. Handling of material from the point where it is received at the plant to a place of storage and/or to the point where it is introduced into the production process requires an equipment system that is consistent with the production facility. Where the product involved is a dry solid in a pelletized, granulated, or pulverized state, there is a distinct trend in industry toward the use of pneumatic systems to automate these handling operations.

This trend is characterized by a conversion from the use of bags, boxes, and drums in which to contain and handle such material, to the use of bulk shipping, handling, and storing means. Latest advances in the design and engineering of pneumatic conveying equipment have made it possible for small as well as large firms to get on the bulk-handling bandwagon. Granulated and pulverized materials of all kinds, TABLE 1, can now be loaded, hauled, stored, and delivered in bulk.

With production costs in other phases of industrial operations steadily rising along with the demand for increased automatic production, the money and time saving advantages of bulk handling assume greater and greater importance.

Basic Problems

Handling of granulated materials usually involves five basic problems: 1. Conservation of time and material. 2. Reduction of maintenance costs. 3. Prevention of contamination. 4. Elimination of dust. 5. Accurate control of the handling operation. The trend toward pneumatic handling appears as a logical step because the past practice of using small containers serves to increase the magnitude of these problems as they apply to automated operations.

TABLE 1—Typical Materials Conveyed In Pneumatic Handling Systems

Alum
Alumina, calcined
Ammonium sulphate
Arsenic oxide
Arsenic trioxide
Asbestos dust

Barley
Bauxite
Beef cracklings
Beet pulp, dried
Bentonite
Blood, dried
Bone char
Borax
Bran

Calcium carbonate
Calcium phosphates
Carbon, activated
Carbon black
Catalysts, petroleum
Cellulose acetate
Cereals
Chalk
Clay, dried
Clay, air-floated
Coffee beans, green
Coffee solubles
Copra
Corn
Corn flakes, brewers
Corn grits
Corn germ
Cottonseed hull bran
Cyanamid

Detergent powders
Dextrin
Diatomaceous earth
Dicyandiamide
Dolomite, crushed

Eggs, dried

Feed ingredients
Feeds, soft
Feldspar, pulverized
Ferrous sulphate
Fertilizers
Flaxseed
Flour
Flour premixes
Fly ash
Fuller's earth

Gilsonite
Gluten meal
Grains, dry-spent
Grain dust
Graphite
Gypsum, raw pulverized
Gypsum, calcined

Iron oxide
Iron salts
Lime hydrated
Lime, pebble
Lime, pulverized

Magnesium chloride
Magnesium oxide
Malt
Meat scraps, dried
Milk, dried
Middlings
Mineral wool
Nylon pellets

Oats

Phosphate rock, granular
Polyethylene

Resin, synthetic
Rice
Rubber pellets
Rye

Salt
Salt cake
Sawdust
Seeds
Semolina
Silex
Soap chips
Soap flakes
Soap powders
Soda ash
Sodium bicarbonate
Sodium phosphates
Soy bean meal
Starches
Stucco, hydrocol
Sugars, refined

Talc
Titanium dioxide

Vinylite
Volcanic ash, pulverized

Wheat
Wood chips
Wood flour

Zinc sulphide
Zinc oxide

Time and Material: The container must be brought to the material. It must be filled and closed. It must be moved to a carrier. At its destination it must be hauled to a storage area. When needed in the manufacturing process, it must be carried to point of use, opened and emptied. And in many cases, containers must then be returned, empty, to the shipper.

Each of these many handling steps involves labor costs. In addition, it is estimated that material losses of up to 2 per cent can be expected due to product sticking to emptied bags. Constant surveillance over each of these different operations is usually needed. Container filling machines, if used, must often be started and stopped time and again in the disposition of a large amount of material into many small containers. A minimum of one operator is therefore involved full-time in an operation which does not even get the material beyond its point of origin.

Two or three men may be needed to get the containers from the filling process to the shipping area. Even if a conveyor system is used, the problems inherent in the natures of the containers and materials are still present, and time-consuming breakdowns always possible.

Manual handling is frequently required to remove the containers from the unit of transportation. Too great care at this point guarding against breakage can waste time, and too great haste to save time can result in material waste. The danger of costly loss, in either one form or the other, is constantly present.

Maintenance Costs: Attempts to mechanize the handling of large quantities of small containers may result in complex equipment installations. Careful consideration must be given to special problems of long distance conveying, moving materials from one level to another and around cor-

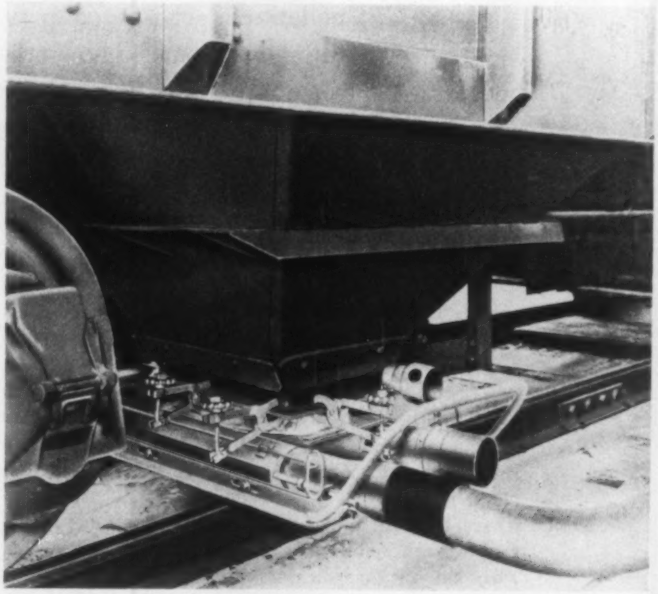


Fig. 2—Twin nozzle equipment attached to bottom of a hopper car. Such arrangements at intake of vacuum systems provide for automatic unloading of bulk material.

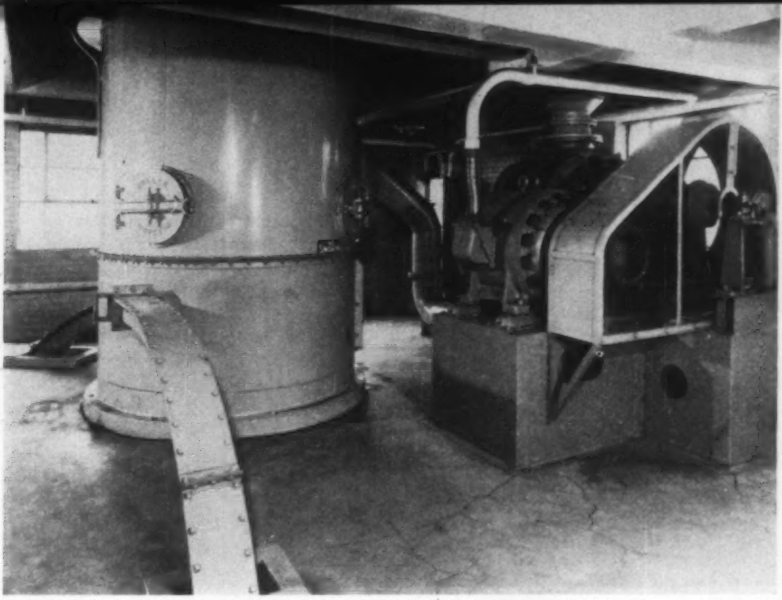


Fig. 3—Receiving filter, exhaust blower, and drive motor at Duquesne Brewing Co. installation. One of the two incoming lines is for car unloading, the other for recirculating. Filter removes solids from air stream and delivers them to scale on floor below.

ners. If these requirements result in the installation of extra mechanical components they will be accompanied by a need for extra maintenance and inspection.

Contamination: The problem of contamination of products is a serious one. This is especially so in the case of food products. Extra packing and packaging is often required, as well as bigger and harder-to-maneuver containers. Equipment that comes in contact with the product must be kept clean. Dead spaces and ledges require routine cleaning. Handling procedures therefore become more complicated as accessories are added to meet contamination requirements.

Depending on the type of container, there is the ever-present possibility of breakage and spillage loss with potential danger to personnel if the material is corrosive or otherwise harmful. Spillage may cause slippery floors and respiratory hazards.

Dusting: Such materials as flour, starch, pulverized coal and coke dust are a constant hazard insofar as the possibilities of fire and explosion exist. Plastics, too, particularly thermosetting compounds, contain dust. Any system not completely enclosed and dust-tight or having a low ratio of material to air is subject to possible explosion.

Control: Handling of the product also involves problems of inventory control and quality control. Depending upon the nature of the system, positive knowledge of exact amounts can become difficult to determine and frequent adjustment of records may be required. With some types of handling there is a danger of purity loss or erroneous proportioning due to improper discharge.

▶ Automated Solutions

Pneumatic handling systems that move these materials through pipes or ducts by suspending the particles in a high velocity air stream offer a desirable solution to the basic problems listed. The necessary air quantity in the pipe can be created either by drawing a partial vacuum at the discharge end or by introducing a positive pressure at the inlet end. Depending upon the requirements of the process, the system designed may be a straight vacuum type, a straight pressure type or a combination of the two known as a pull-push system.

Basic straight vacuum systems, *Fig.* 1, consist of an intake device, a conveyor pipe, a receiver, an exhauster, and an air lock. The intake device is usually a hopper bottom, *Fig.* 2, fitted with an air inlet nozzle or may be a flexible metal hose equipped with a nozzle arrangement. In each case the open end of the pipe is exposed to the bulk supply of the product and a chamber surrounding the pipe is vented to atmosphere and open to the pipe interior so that under no circumstances can the product choke off the incoming air.

The product is carried through the conveyor pipe system by an airstream which terminates in a receiver chamber. The large volume of space in the receiver decreases the velocity of air and the material drops out of suspension. Air is exhausted from the top of the receiver by a positive displacement blower, *Fig.* 3. This exhauster creates the partial vacuum that causes the air movement in the system.

To permit the product to be released from the bottom of the receiver without admitting air at this point an air lock must be provided. This may be a series of gates allowing material to drop in stages such that one set of gates is always closed; or it may be a rotary feeder type resembling a revolving door, allowing chambers to be opened alternately to the inside and outside of the receiver, but never allowing uninterrupted air flow.

The receiver itself may be only a cyclone type separator or it may be a combination filter-receiver which is fitted with filter bag chambers that remove dust from the air before it is exhausted.

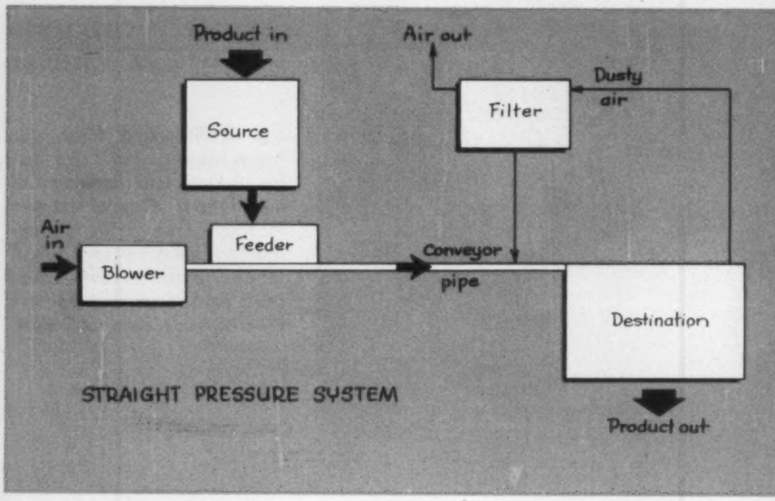


Fig. 4—Block diagram of straight pressure system of pneumatic handling. Material enters air stream on pressure side of blower. Destination is usually an enclosed bin or hopper. If material is dusty, air leaving destination of the material is filtered to remove dust. Product removed in the filter is either reintroduced into conveyor pipe or collected separately.

Basic straight pressure systems, *Fig.* 4, use air from the pressure side of a blower. A feeder meters the product from the hopper or bin that is the source of supply. As the material falls into the moving airstream in the conveyor pipe it is carried along to the hopper or bin that is the destination. For dusty materials it is common practice to put the outgoing air through a filter before releasing it to atmosphere. Product separated from the air in the filter may be reintroduced to the conveyor pipe or collected separately, *Fig.* 5.

Pull-push systems, *Fig.* 6, combine the vacuum arrangement to introduce the product into the system and the pressure hookup to send it on to its destination. A single positive pressure blower can be utilized to obtain the vacuum at its inlet side and the pressure from its exhaust.

The vacuum system lends itself to complex layouts where intake to the conveyor must be from multiple sources. Pipe switches in the conveyor permit the receiver to be hooked up to the selected intake of material. In a pressure system pipe switches in the conveyor provide for delivery to a multiple number of destinations. Combination systems can therefore be arranged to pneumatically pick up material from selected sources and deliver it to selected destinations.

Use of remotely controlled switches, *Fig.* 7, bin level indicators, and automatic weighing hoppers can permit pneumatic handling installations to be operated in a highly automatic manner. These devices are wired into control panels, *Fig.* 8, such that entire systems can be controlled from a central location.

▶ Operating Examples

Effectiveness with which the basic problems of handling granulated or pulverized materials have been solved by pneumatic systems may be observed in reviewing features of some installations.

Time and Material: At a textile plant of Avondale Mills, starch was formerly received in bags in carload lots. It took an 11-man crew 4½ hours to unload the bags and carry them to storage.

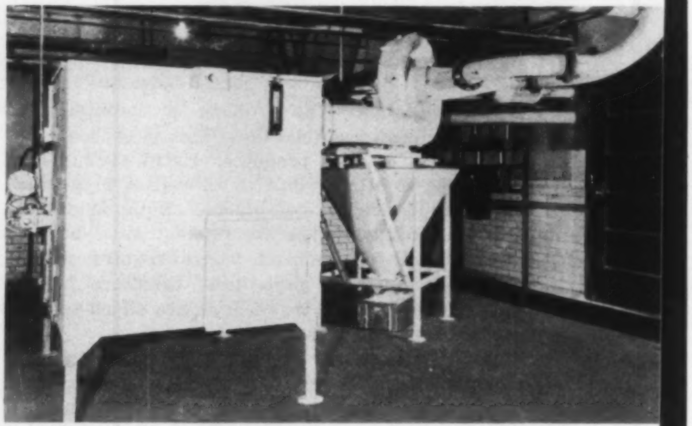


Fig. 5—Special dust collector through which air from weigh-hopper is filtered at Ward Baking Co. installation. Purpose of equipment is to insure retention of flour particles.

Now starch reaches the mill in 60,000-pound capacity railroad hopper cars where it is unloaded by one man in four hours. In addition to money savings from labor, cost of the starch itself is 15 cents a hundredweight below paper bag price and 30 cents below cloth bag price. A Fuller Airveyor system of the vacuum type makes these savings possible.

In operation, an intake nozzle on a flexible metal hose is attached to the bottom of a hopper car. A positive-pressure exhauster, V-belt driven by a 40-hp motor, creates a partial vacuum in the material collector and pipeline which feeds the starch to a 160,000-pound storage tank. Rate of transfer is approximately 12 tons an hour, without dust or loss of material.

A bypass valve at the top of the tank can be adjusted so the starch will feed either to the main storage tank or be routed directly to the slasher room. Feed to the supplementary storage tank in the slasher room automatically cuts off when the tank is full. Experience with such an installation shows a saving in handling costs from $7.96 to $7.02 for each 100 pounds of starch.

Maintenance Costs: Less than $100 a year in maintenance costs is reported from an Airveyor system which unloads, stores, reclaims from storage, and delivers bulk flour and sugar to the production process at the Overbrook Bakery of the American Stores Co. A company spokesman declares that the pneumatic handling of bulk material has been an important factor in bringing the total handling costs of the plant down to approximately 5 per cent of total costs.

The installation includes two independent pneumatic conveying systems. Either can be used for unloading or reclaiming. Here, one man, working at a central panel, controls the handling of virtually all flour and sugar. He can unload railroad cars or trucks at four different stations, route the material to any of 20 storage silos, then reclaim it from storage and deliver it to any one of 12 "use" bins.

The system operates as follows: A detachable hose empties Airslide or Transflo cars at the rate of 20 tons per hour. Flour or sugar is conveyed under partial vacuum into a receiving filter of the continuous fully automatic type. Solids are taken out of the air stream here.

Flour is then discharged through an air lock into a sifter and infestation destroyer (sugar bypasses this step) and through a second air lock into the blower line. Flour is then pushed under pressure to cyclonic separators at the top of the storage silos. Air is filtered and exhausted, and filtered material is returned to the blowing line. Remote control valves direct flour into appropriate 150,000-pound capacity silos.

At the bottom of each silo, the material drops into a vacuum line and again passes through filter, sifter, and infestation destroyer (or bypass) and discharges into blower line for delivery to use bins.

Contamination: The Ward Baking Co. has changed to pneumatic handling of flour in six of its major plants. According to P. R. Inglis, the company's former Chief Engineer, the principal reasons for the changeover were the sanitary and self-cleaning features of the pneumatic system.

Installation of the Airveyor at the Newark plant, for example, replaced a system of three screw conveyors. With these mechanical handling units, flour collected in dead spaces and on structural ledges. Every two weeks four mechanics and 12 porters had to dismantle, scrape down and clean the entire system. This made over 200 extra working hours a month. Pneumatic handling eliminates the need for this nonproductive operation.

Dusting: Possibility of dust explosion in handling many granular materials is very high. At the Indianapolis plant of Western Electric Co., where telephone sets are manufactured, phenolic resin compounds (thermosetting) and cellulose acetate type compounds (thermoplastic) are used in great quantities.

These materials were originally obtained in 250-pound drums, creating problems with handling, storage, stock control and containers. Also, usual handling methods in the molding department resulted in undesirable conditions, especially spillage. This caused waste as well as slippery floors and respiratory hazards.

Most serious, however, was the possibility of dust explosion. When E. C. Lang of the company's Indianapolis Factory Planning Div. began an investigation of other handling methods, tests in pneumatic systems showed that the velocity and

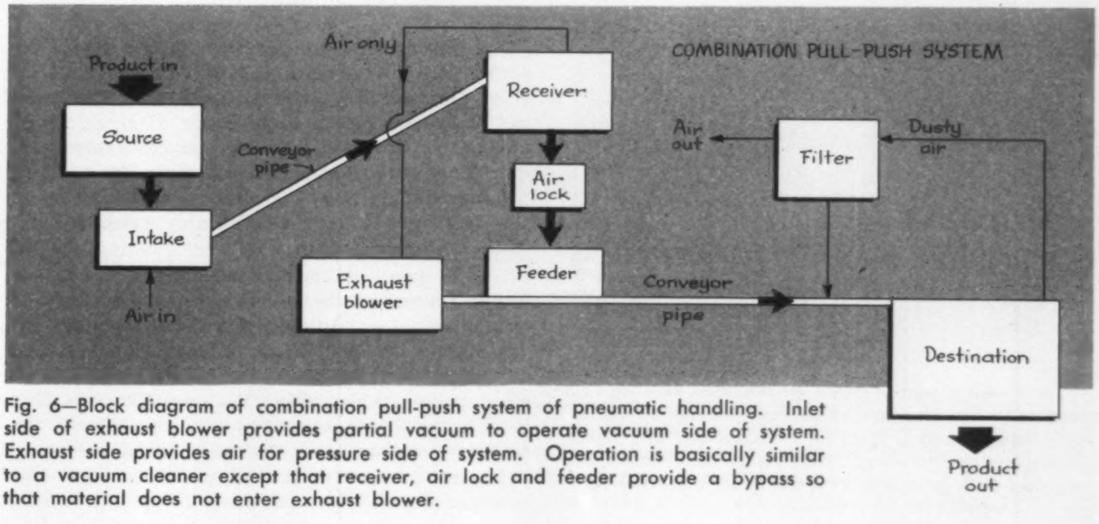


Fig. 6—Block diagram of combination pull-push system of pneumatic handling. Inlet side of exhaust blower provides partial vacuum to operate vacuum side of system. Exhaust side provides air for pressure side of system. Operation is basically similar to a vacuum cleaner except that receiver, air lock and feeder provide a bypass so that material does not enter exhaust blower.

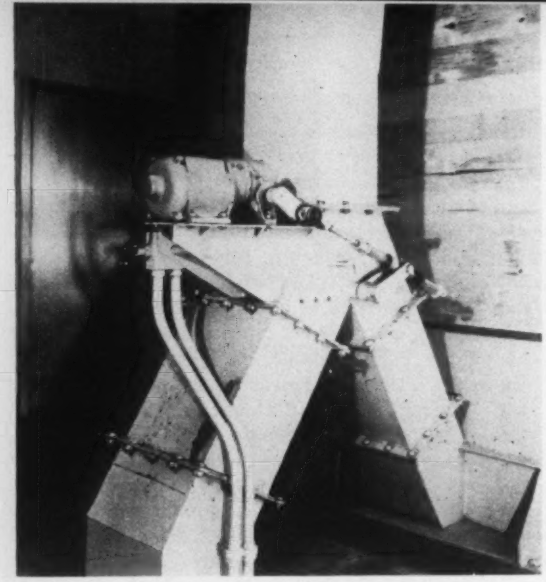


Fig. 7—Typical remotely controlled two-way gate in a pneumatic conveyor line directs flow of material into alternate lines.

turbulence in the lines and the high ratio of material to air would not support ignition.

Practically all incoming shipments now are in bulk. Dual systems of 5-inch diameter suction piping extend about 400 feet from the unloading dock to Airveyor equipment from which the compounds are delivered under pressure to the storage tanks. The conveying capacity of each system is 10,000 pounds per hour.

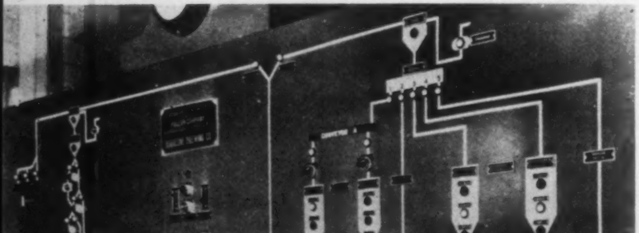


Fig. 8—Graphic control panel at Duquesne Brewing Co. installation provides remote control of handling equipment from a central location. Pushbuttons and lights enable operator to set up system to move material from receiving dock to selected storage point and from storage to process.

A conveyor suction manifold pipe is installed along the bottom of each row of tanks and is connected to an outlet flange on each tank through a motorized combination air lock and feeder.

Compound is fed at a predetermined rate from the bottom of any one tank into the suction manifold and flows into the conveyor machinery house from which it is delivered under pressure to either of two 5000-pound process tanks which are located about 200 ft away and above the roof of a building annex containing the preform presses.

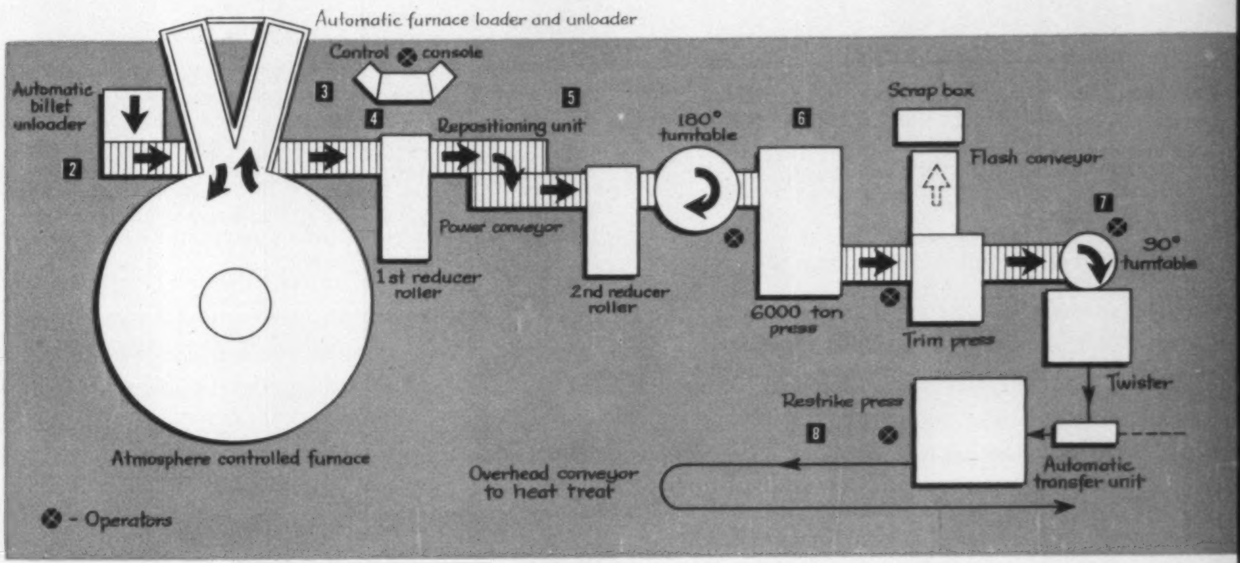
From either of these tanks the compound is gravity fed through chutes down to hoppers on the presses. This arrangement provides the flexibility whereby either of two different brands of compounds can be supplied to any press at any time. Except for short periods twice a day when the process tanks are being refilled, the conveying system is available for unloading incoming shipments.

Control: Lack of efficiency in weighing and batching can be one of the biggest contributors to the inaccurate control which leads to inventory problems. The ease of combining electronic control panels and weighing devices with pneumatic conveyors provides the solution to these problems. The Duquesne Brewing Co., which can produce over 2,000,000 barrels of beer a year, makes use of Airveyor systems. When a carload of grain—whether it be malt, corn-grits or rice—is moved onto the siding adjoining the brewhouse, an 8-inch conveyor line sucks the grain to the eleventh floor in a single operation. Airveyor equipment also serves to distribute the grains to different parts of the brewhouse. One of the features of the brewhouse is an electric control panel, on the fifth floor, which controls the complete movement of the grains throughout the operation—from the railroad cars, through all the various weighing and sorting operations, in and out of the storage bins.

▶ Engineered To Suit

Pneumatic handling systems of the types described are individually tailored for the material to be handled, the functions to be performed, and the plant installation to be made. The basic type of system chosen and the system components required are dependent on these factors. For example the use of dust filters, their type and location in the system will vary considerably from one installation to another.

Under these circumstances criteria of economic evaluation cannot be stated generally but depend on individual conditions. A rule of thumb that has been used is that if production is as high as one carload per week, pneumatic handling can effect economy. Experience has provided specialists in this field with the know-how to evaluate the savings possible when this method of achieving increased automation is analyzed for a particular process.


Automatic furnace loader and unloader
Control console
Automatic billet unloader
2
3
4
5
Repositioning unit
180° turntable
6
Scrap box
Flash conveyor
7
90° turntable
Power conveyor
1st reducer roller
2nd reducer roller
6000 ton press
Trim press
Twister
Restrike press
8
Automatic transfer unit
Overhead conveyor to heat treat
Atmosphere controlled furnace
⊗ - Operators

1 Flow diagram of the integrated crankshaft forge line. Powered materials handling equipment automatically speeds the hot billets through the entire crankshaft line, turning out a forged crankshaft in less than 90 seconds.

AUTOMATION TODAY

CONVEYORIZED FORGING LINE

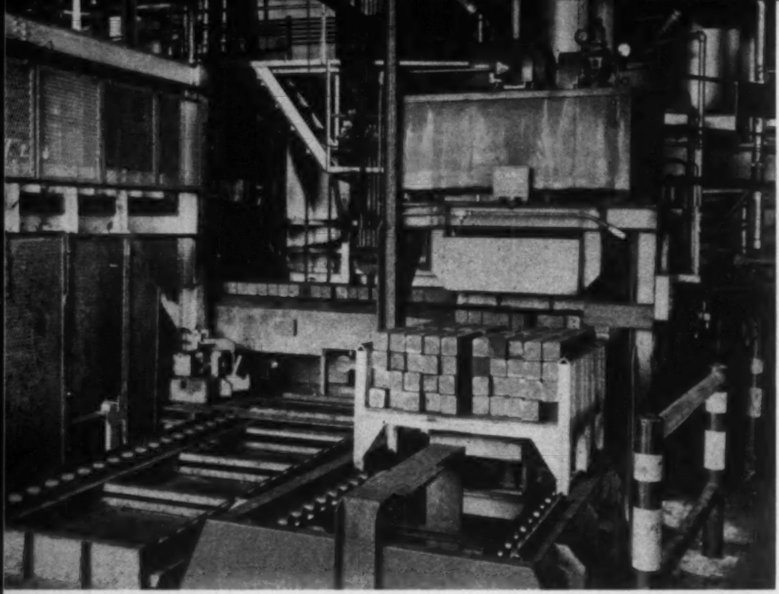
SPEEDS HOT BILLET HANDLING

HIGHER COSTS and stiffer competition have led the forging industry on a continuous search for newer, more efficient production methods. It is recognized that better, more scientific forgings can be produced with pressure machines at reduced cost and with less noise. It is also recognized that a more efficent forging line will result if manhandling of billets is eliminated as much as possible by using special materials handling equipment.

This approach was applied in designing the new crankshaft line in the Oldsmobile Forge Plant at Lansing, Mich. Crankshafts for several General Motors divisions are forged in this plant, and it must be able to meet independent forge plant competition to keep its division business.

In 1955, Oldsmobile forge engineers designed and started work on their first integrated crankshaft production line. The steam-hammer forger with its multiblow action was to be discarded. The engineers planned to utilize a 30-foot atmosphere-controlled Lithium furnace which would produce minimum scale billets at 2300F. The billets would then progress through two National reducer rollers, a 6000-ton National mechanical press, a Bliss trim press, an Ajax twister, and a Bliss restrike press. The Planet Corp., Lansing, Mich., was engaged to aid in designing, manufacturing and installing the materials handling system since the success of the entire line depended upon crankshaft billets moving continuously through the complete line without losing forging temperature.

Accompanying illustrations vividly illustrate the size and complexity of the automated crankshaft forge line. The entire operation is directed by one man at a control console near the furnace. Although the billets are never lifted by an operator, they are rolled, levered, or otherwise manually guided at four stations by means of mechanical aids. Formerly, after heating, three minutes were required to complete one crankshaft. The same operation is now accomplished in 90 seconds.



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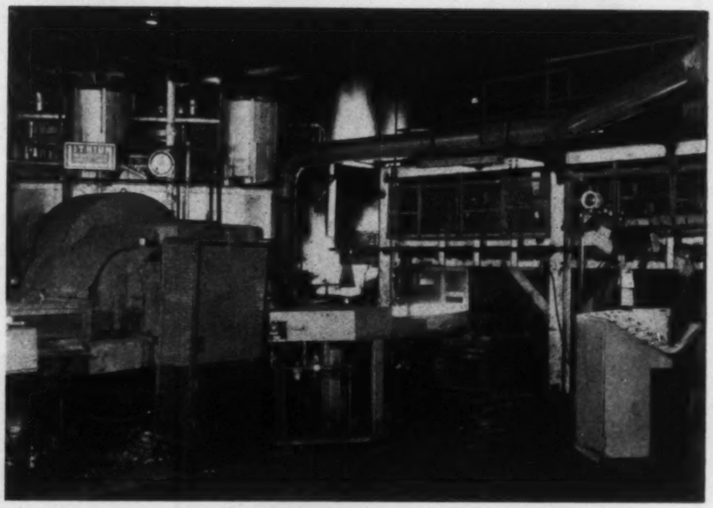
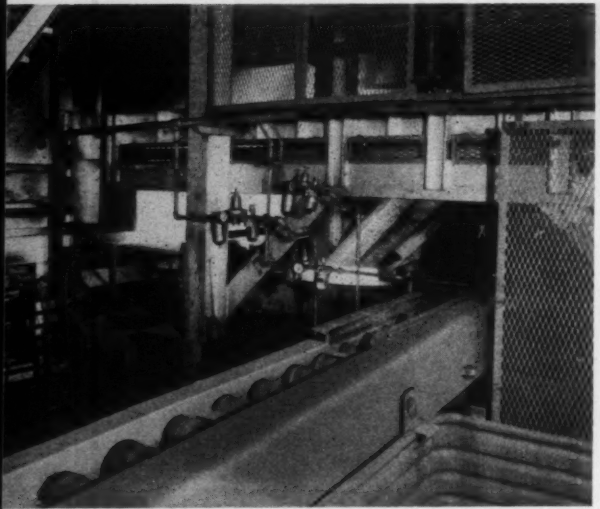
This is the beginning of the integrated Oldsmobile crankshaft forging line. A Planet automatic rack unloader feeds a steady flow of billets to the furnace charging boom and then moves the empty racks away for pickup. From this stage forward, the billets are conveyed automatically until they become crankshafts.

3

Charging boom manipulators automatically load and unload billets into the 30-foot atmosphere-controlled Lithium furnace. After 90 minutes in the furnace, the 2300F billets are conveyed to the number one National reducer roll which preforms two sides of the billet. The operator control console for the entire forge line is at the right of the picture.





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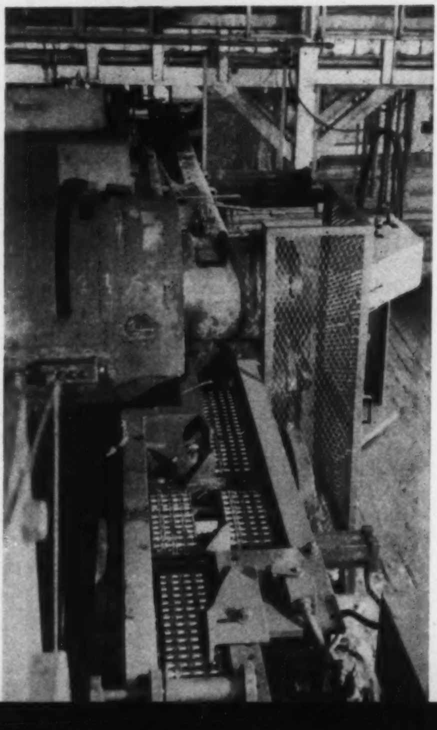
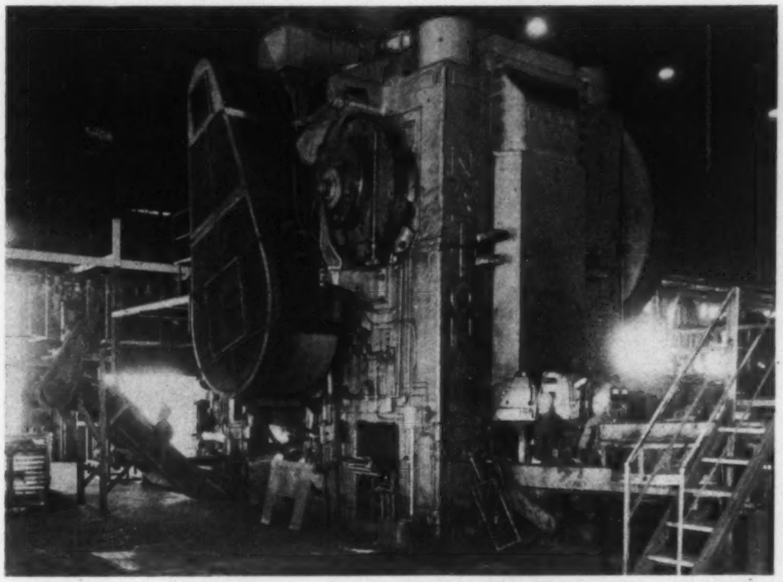
View of the powered Planet roller conveyor used to transport the white hot billets from the furnace to the first National reducer roll. A similar unit is used between the second reducer roll and the 6000-ton National mechanical press.

5

Roller chain repositioning unit located between the first and second reducer rolls automatically turns the hot billets on their sides. The second reducer roll preforms the remaining two sides of the billet.





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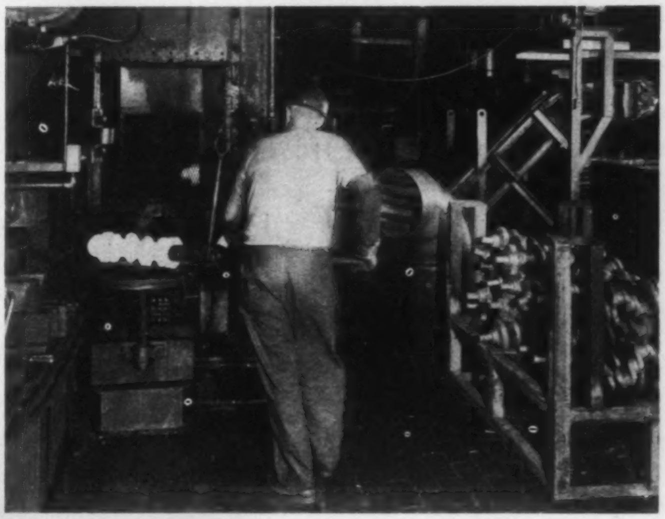
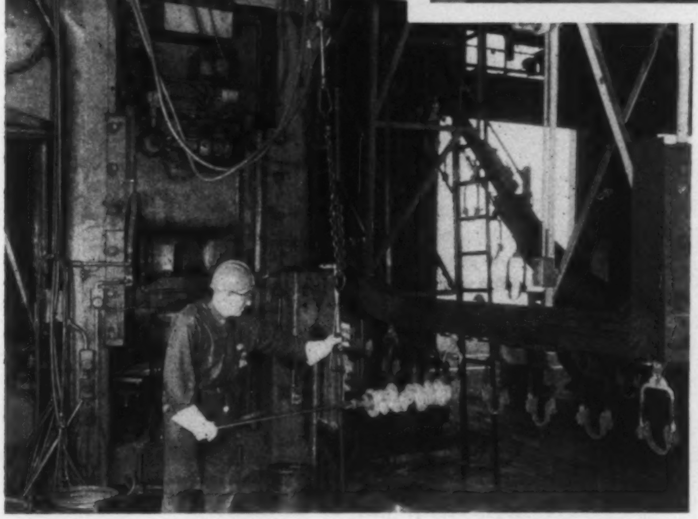
Preformed billets are conveyed onto the bed of a 6000-ton National mechanical press where a cylinder pushes them onto the blocker die. After blocking, the operator rolls the units into the finish die which forms the crankshaft.

7

Flash is removed from the white hot crankshaft on a Bliss trim press. The trimmed crank drops through the die and is pushed out of the press by an air cylinder and conveyed to a waiting operator at the twister. Flash is pulled out of the trimmer and conveyed automatically to a scrap container. The twister operator levers the crankshaft on a turntable into the Ajax twister on the left.





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Final forging operation occurs in the Bliss restrike press. Following this, an operator levers the crankshafts out of the restrike die and places them on an overhead trolley conveyor for transport to heat treat operation located in another part of the plant.

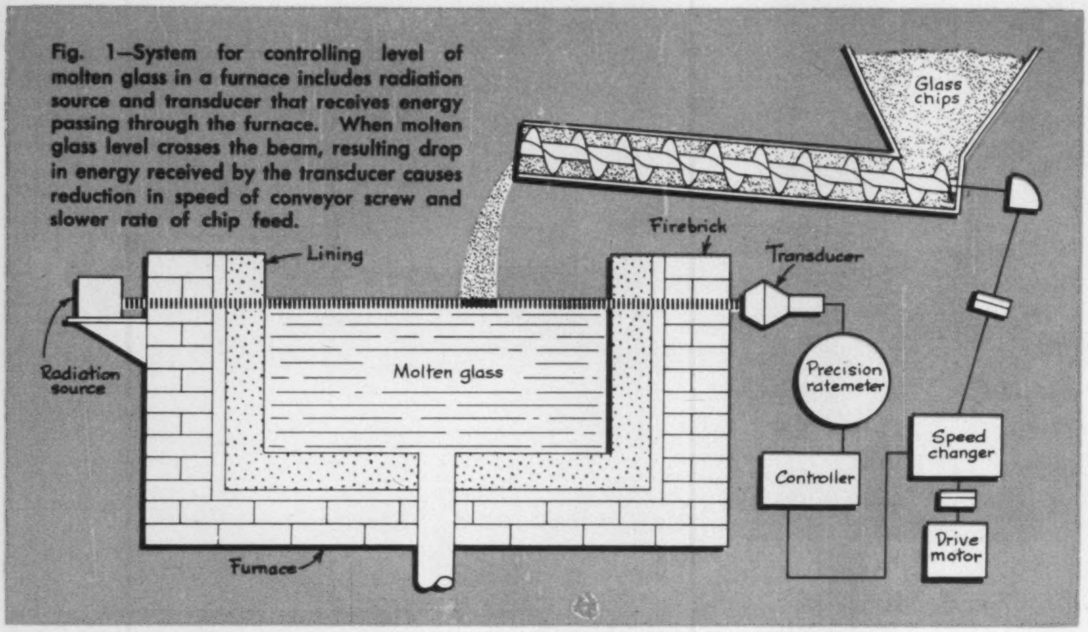


Fig. 1—System for controlling level of molten glass in a furnace includes radiation source and transducer that receives energy passing through the furnace. When molten glass level crosses the beam, resulting drop in energy received by the transducer causes reduction in speed of conveyor screw and slower rate of chip feed.

RADIATION GAGES IMPROVE

BULK MATERIAL LEVEL CONTROL

By **STELIOS REGAS** Technical Supervisor, Special Products Dept., Tracerlab, Inc., Waltham, Mass.

Potential of radioactive isotopes for reducing manufacturing costs and performing otherwise difficult tasks is becoming increasingly recognized by industry. Here, some of the present-day applications to level measurement will be described. Principles, rather than specific details, are stressed.

NUCLEAR DEVICES are a relatively new weapon in the constant struggle to cut manufacturing costs and advance product quality, and their applications are receiving increasing attention by alert management. A general description of industrial applications of radioactive isotopes in regular use today will demonstrate some of the advantages to be gained by their use. It is best to think of principles rather than specific applications if one is to appreciate the possibilities of nuclear devices in solving a wide variety of manufacturing problems.

The device which will be described is a bulk material level gage. Its operation, advantages, feasibility from the standpoints of safety, economics and practicality, and some of its industrial applications will be discussed.

▶ Level Sensing

A common application for nuclear gages is in the detection, at a certain level, of the presence or absence of a liquid or a granular substance such as coke, plastic pellets, and even corn flakes. Gages of this type also have proved their value in difficult applications such as measuring levels of corrosive substances, fluids at low temperatures, and molten metal and glass in furnaces. A system for measuring and controlling molten glass level in a furnace is diagrammed in *Fig.* 1.

The interest in knowing the level is usually prompted by the desire to avoid overflowing of a vessel. The cost of an entire coke-level indicator installation, for example, may be less than the cost of cleaning the overhead lines and fractionation tower after a single spill-over.

Another example of the use of nuclear level-measuring equipment is in avoiding the hazard of allowing a container such as a fuel supply tank to run empty, *Fig.* 2. Of course, it is possible to remain within safe limits by switching tanks while there is some fuel left. Many industries follow this procedure, but it is not always to their best economic interest. If in a large power plant, for example, it is possible to run fuel levels closer to the desired minimum by even a fraction of an inch, and at the same time have assurance of safe operation through level control, substantial savings may often be made. These savings accrue through increased accuracy in cost accounting, in rate setting, and through reduction of inventory. Automation of this type not only gives visual indication of the rate of consumption of fuel, but through closer control of level can reduce the capital investment in stagnant fuel which is never used.

The liquid level gage falls in the general category of density gages. It measures, or rather senses, the difference in specific gravity between the liquid and the medium above it, which in most cases is air. The phrase "in most cases" is used deliberately; application requests are sometimes received for the detection of the interface between two nonmixing liquids which have different densities.

▶ System Considerations

In designing a nuclear liquid level gage the first consideration is the radiation source. Choice of source may be made from a great variety of radioactive isotopes. In the past, Cobalt-60, Cesium-137, Strontium-90, and Iridium-192 have all been considered. The factors determining the selection of isotope are energy level of emitted radiation, half-life considerations, cost, maintenance, and most important, safety during installation and in use.

Cesium-137, for example, comes in powder form and in accordance with AEC regulations, requires periodic tests consisting of wiping the source container with a cloth and checking the cloth on a monitor to see if any source material has been picked up. Cobalt-60 is in the form of a piece of metal or a wire, and does not require checking. Also, in case of an industrial accident it is much easier to retrieve a solid piece of metal than a powder. The powder can be carried all over the area in visually undetectable amounts on shoe soles. This can create fear at the least, and radioactive contamination of an entire area in some cases. Equally important to some, of course, is loss of the shoes!

Energy level of the source is important because it must be high enough to penetrate the walls of the container and any insulation, supports, etc., but not so high as to constitute a hazard or require excessive or expensive shielding.

After determining the type of source to be used and the amount needed there is the problem of selecting the container and any shielding that might be required. Several kinds of source mounts have been developed which have fail-safe mechanisms and malfunction indicators. They provide for automatic withdrawal and shielding of the source in the event of power or equipment failure.

One commercially available source container, or camera, can safely hold up to 150 curies of Iridium-192, 15 curies of Cesium-137, or 80 millicuries of Cobalt-60. It has no less than three inches of lead covering any particular point of the radioactive isotope. It can be safely shipped and its construction eliminates the need for any special handling during installation. Radiation emitted from this camera is in the form of a 60-degree

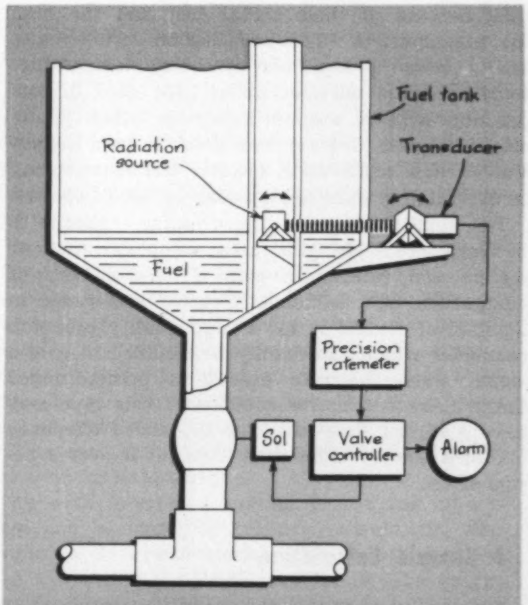


Fig. 2—Radiation gage installation for controlling level of fuel in a large tank. Adjustable mounts for source and transducer units allow control of level within fraction of an inch of desired height.

cone which can be restricted if desired by adding a special collimator to the opening.

Need for external shielding depends on the camera used and the particular application. Some installations require no external shielding, while others are shielded both at the surface level and in the area surrounding the camera.

Some of the radiation from the source—that emitted by the inner layers of the material—will be absorbed by the outer layers. Some will be absorbed by the walls of the container, and more will bounce around or scatter. The remaining energy will arrive at the transducer. This quantity is the useful part in the automation process. If between the source and the transducer a material is inserted that has a different absorption characteristic from the gas, air, or liquid that is displaced, the useful amount of radiation will change. It is this change in energy level that provides a means for automatic level control. By comparing the source energy that passes through the material with a preset standard energy level, corrective signals may be generated.

Next step is selection of a transducer. A Geiger-Mueller tube will do the job, but this device has a life limit whether used or not. Because of its low efficiency (about one per cent), it requires a strong radiation source. Scintillation counters offer the advantages of having no life limit, higher efficiency, and better statistical accuracy. However, they are more expensive than the Geiger-Mueller tube because of their actual cost and the need for preamplifiers. The scintillation counter also has a lower permissible operating temperature because of the photomultiplier tube used in conjunction with a sodium iodide or other photoelectric crystal. Temperature limits in both Geiger-Mueller and scintillation counter transducers may be overcome in some applications by use of coolers.

The final component—the detector—remains to be considered. In this area complete lines of scalers and ratemeters with a wide variety of adaptations are available. General preference in liquid-level control is for a high quality precision ratemeter which can readily be modified to give a signal when the rate exceeds a predetermined limit. Sensitive instrumentation of this type may have a higher first cost, but the added efficiency obtained usually more than pays for it over a period of use.

Sample Calculation

Suppose it is desired to provide a nuclear level gage for the molten glass furnace shown in ***Fig.*** 1. This furnace spans 2 feet on the inside, and includes 3-inch thick firebrick walls enclosing a 4½-inch thick lining. Sufficient useful radiation must penetrate the entire furnace to generate a level-control signal at the transducer.

Because the temperatures around the furnace are very high we shall use Cobalt-60 for the source and a Geiger-Mueller tube in the transducer. Since the background count, or noise level is around 200 counts per minute (cpm), we shall select a signal level of, say, 2000 cpm. This is chosen because a signal-to-noise ratio of ten is adequate, and a rate of 2000 cpm is low enough not to require too strong a source.

Looking at the Geiger-Mueller tube dimensions, we see that they are 0.8 x 4 inches, which provides an area of 3.2 in.^{2} The distance between the tube and the radiation source is 39 inches. A sphere having a radius of 39 inches has a surface area of 19,100 square inches. Thus, of the total radiation emitted by the source, only 3.2/19,100 or 1/5970 will impinge on the face of the transducer at this distance. This assumes of course that there is no absorption by intervening media. This figure indicates that 2000 x 5970 or approximately 12×10^6 cpm will be required of the source to provide the desired 2000 cpm at the transducer, neglecting efficiency and loss factors.

The efficiency of the Geiger-Mueller transducer is about one per cent. Assuming one count is detectable per disintegration of the Cobalt-60 source, 12×10^8 disintegrations per minute (dpm), or 2×10^7 disintegrations per second (dps) are therefore required, neglecting losses.

It remains to calculate the magnitude of radiation loss through the furnace and increase the source strength accordingly. In this case there are 6 inches of brick. Half-thickness of brick, or the thickness of brick that will absorb half the radiation of Cobalt-60, is 7.5 inches, so there are 6/7.5 or 0.8 half-thicknesses of brick. Half-thickness of the lining is 1.6 inches, and for the 9 inches of lining there are 9/1.6 or 5.6 half-thicknesses. Adding the two, we get 6.4 half-thicknesses of media to overcome. Therefore, the source strength must be increased by a factor of $2^{6.4}$ or 84 to provide the desired count rate at the detector. This means a source disintegration rate of $2 \times 10^7 \times 84$, or 168×10^7 dps, will be needed. Since 3.7×10^7 dps occur in one millicurie of a radioactive nuclide, 168/3.7 or 45.4 millicuries of Cobalt-60 will be required as a source. This is a reasonable amount, and one that can be easily handled in a camera.

Before the installation of this liquid level gage, molten glass level was checked periodically by an operator with a rod. Many times, if he was late, or the feeding was too fast, the furnace would overflow. The new system incorporates a conveyor drive speed control to keep the molten glass at the desired level.

Applications such as those given here serve only to hint at the broad industrial potentials inherent in nuclear devices for reducing cost and performing otherwise difficult gaging operations. Their use in measuring the oil level in power transformers and the content level in tin cans can be anticipated. It is through imaginative application of new devices and new principles such as these that progress in automation will be accelerated.

DIMENSIONAL CONTROLLING SYSTEMS

2

POST-PROCESS GAGING

PROVIDES VERSATILE MACHINE CONTROL

The first article in this series of three devoted to dimensional controlling systems involved in-process machine control. Here the author describes how the same basic components of in-process gaging systems are used to provide post-process control of machines and classification of workpieces.

By R. ALLEN SOULER, Automatic Gage Engineer, Federal Products Corp., Providence, R. I.

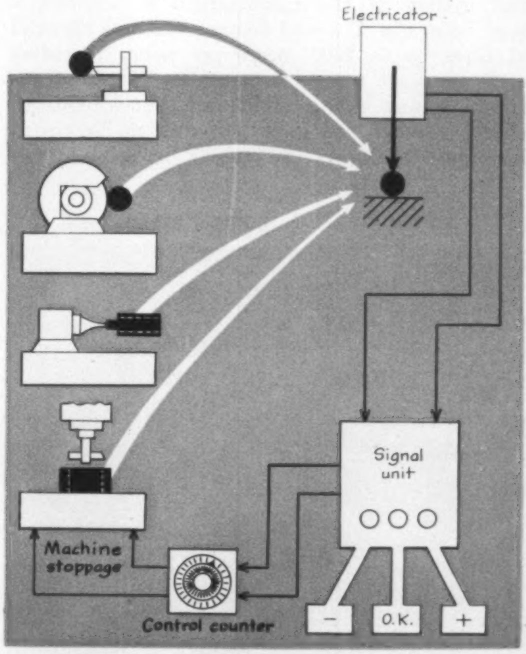


Fig. 1—Post-process gaging is applicable to a wide variety of machine processes. As shown, work is gaged after machining; on the basis of the sensings, the parts are then sorted into classifications. Machine can be stopped if an undesirable number of successive workpieces fail inspection.

AFTER-the-machine or post-process control gaging is much more versatile and therefore, applicable to a wider range of equipment than in-process gaging, although the basic components of the two types of systems are generally the same. Despite the use of similar components, the overall gages differ considerably in appearance and purpose.

In most applications of post-process gaging, the gages perform two functions. First, the units measure, classify and sort parts from the machines they serve. Secondly, they can provide signals to compensate for machine drift, keeping the parts being produced within established tolerance limits. In addition, when the gages sense that unacceptable parts are being produced, they will automatically shut off the machine and signal the need for adjustment.

As with in-process gaging, four types of systems can be identified: electric, air-electric, electronic, and air-electronic. The electric system, *Fig.* 1, provides the simplest means of after-gaging and feedback control, and is lowest in initial cost. It is capable of inspecting from 80 to 100 pieces per minute and usually operates to accuracies of 0.0005 inch or better. An electric control system combines a dial indicator with a dual switch mechanism, which accurately links gage contact movement with an electrical impulse. The electrical

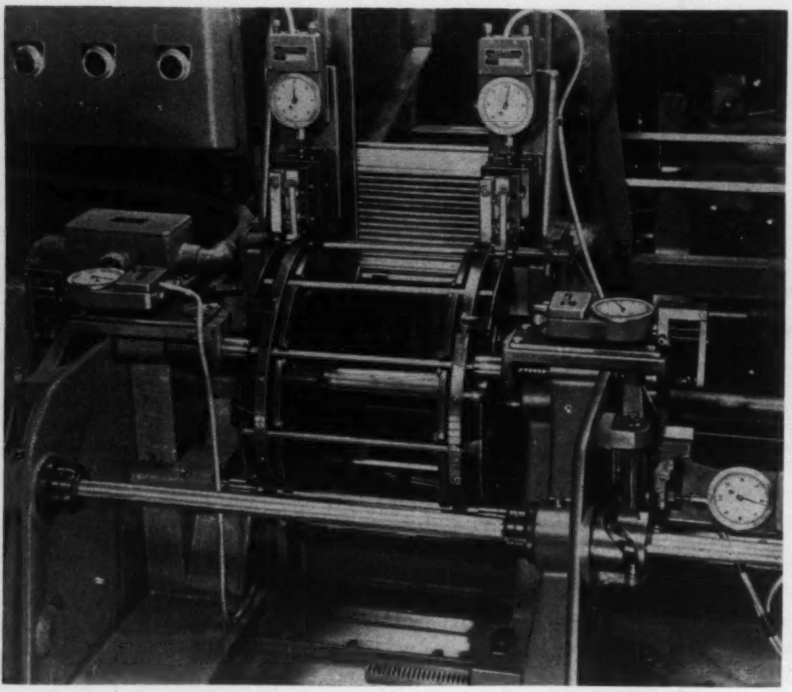


Fig. 2—Automotive push rods are gaged automatically with electric system by which the five gages shown check the OD at two points, chamfer diameter at both ends, and length of the rod. The cold heading machine ahead of this gaging operation will be stopped if an excessive number of rejects are made.

gage provides visual indication of work size and requires only one master for setting. The switching limits are easily set according to tolerances of the parts to be inspected. Signaling devices indicate the size classification of each workpiece inspected.

Electric systems can be used after any machine process to sort work into oversized, good, and undersized pieces. With the addition of a control counter, the unit will shut off the associated machine when a preset number of unacceptable pieces have been gaged.

In a typical application of an electric control system in the manufacture of automotive push rods, *Fig.* 2, a cold heading machine operates at rates up to 2500 pieces per hour, depending upon the sizes being produced. By means of five electric indicators, one signal unit, and a predetermining counter, the gage performs the following functions: 1. Checks the outside diameter at two

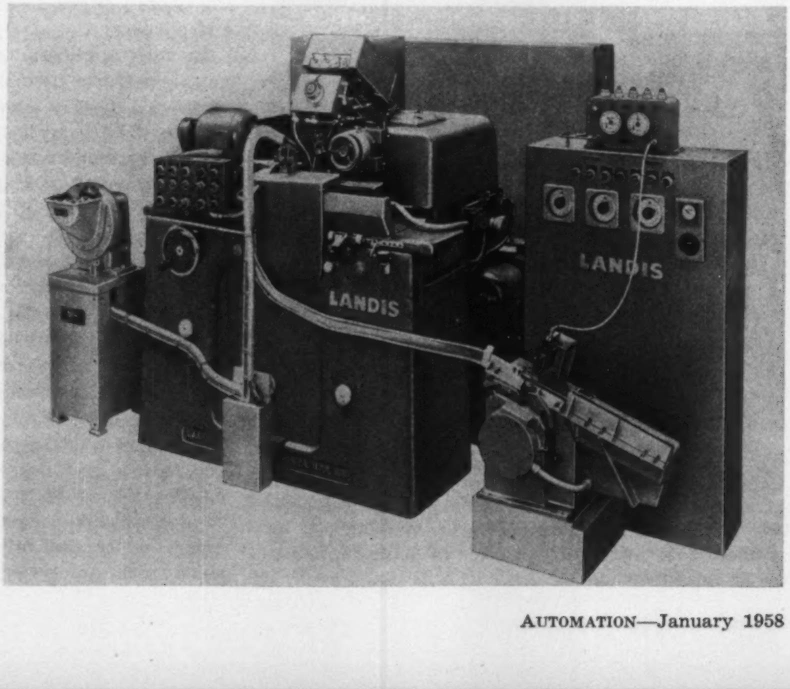


Fig. 3—In grinding operation involving inner ball bearing race, the OD of the ball track is checked by air-electric gaging system. Parts are classified over, under, and good by control, and the machine adjusted automatically when sensing indicates significant drift has occurred.

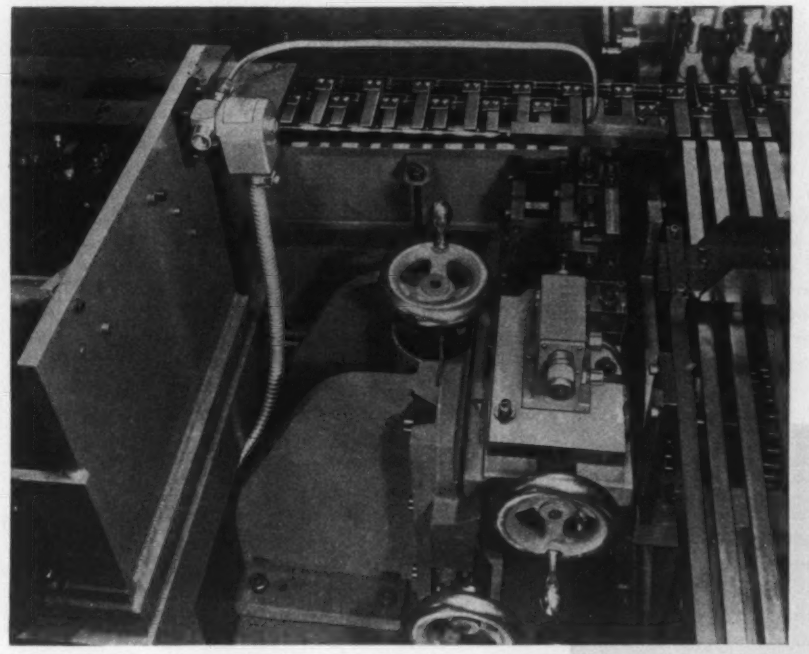
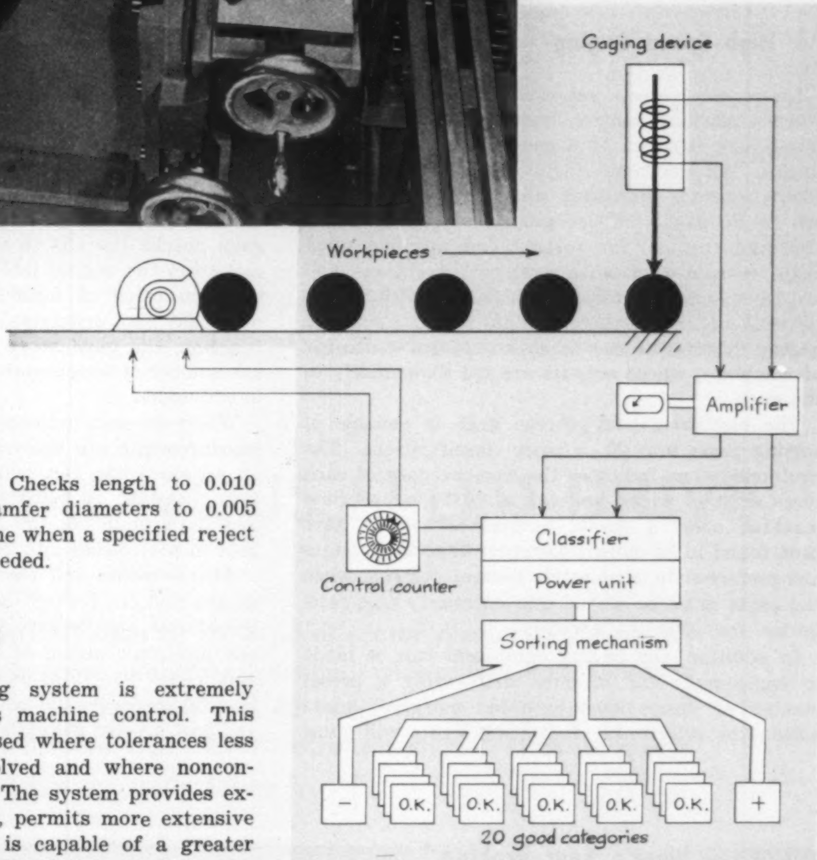


Fig. 4 — Electronic gaging head, through pantograph mounted contact, is used to stop centerless grinder in glass rod grinding operation. Output from grinder is sorted into 20 good classifications by the gaging control.



points to 0.001 inch. 2. Checks length to 0.010 inch. 3. Checks both chamfer diameters to 0.005 inch. 4. Stops the machine when a specified reject percentage has been exceeded.

▶ Noncontact Gaging

The air-electric gaging system is extremely versatile for post-process machine control. This gage is most generally used where tolerances less than 0.002 inch are involved and where noncontact gaging is desirable. The system provides extremely smooth operation, permits more extensive after-gaging control and is capable of a greater repetitive accuracy than the electric system.

The system can be used for sorting and machine stoppage with two-limit control. Work can be sorted into five or more in-tolerance classifications, with the gage indicating the classification of each piece and stopping the machine when unacceptable work is produced. In addition, by providing multilimit control, the system can send corrective signals to the machine to compensate for drift before cutting any out-of-tolerance parts.

This system of machine control gaging has been used with internal and external grinders, boring machines, turning machines, and surface grinders. The machine must be able to carry out the corrective action indicated by the gage.

Air-electric equipment for post-process control gaging includes an air gage with air rings, plugs, or air probe, and air-electric switch units. Single, double, and four-limit air-electric switch capacities (or any combination thereof) establish electrical impulses as a result of changes in air pressure due to dimensional variation. Finally, signal units are incorporated in the systems to suit individual needs for visual or audible signals.

In a typical air-electric control system, *Fig.* 3, the ball-track diameters of inner ball bearing races are checked to a tolerance of 0.0005 inch. The equipment involved includes a retracting contact with an air probe, a four-limit switch and a signal unit. Working at a rate of 40 pieces per minute, the system sorts pieces into oversized, undersized and good classifications. In addition, it compensates for machine drift through its control unit, providing corrective signals where parts exceed marginal limits set up within the tolerance extremes.

High Speed Gaging

Electronic systems are used frequently in post-process machine control, particularly where high speeds are required or a continuous signal is desirable. Air-electronic gages are normally applied where internal diameters and surface conditions are to be gaged. These gaging systems provide multilimit control for sorting and machine stoppage in connection with external operations and are capable of accuracies as high as 0.00001 inch. Because of their inherent high speed, electronic gaging systems of this type can control a number of machines, whose outputs are fed sequentially to the gage.

The electronic post-process gage is capable of sorting parts into 20 or more classifications. The equipment thus indicates the size category of each piece as it is gaged and can stop the appropriate machine after a preset number of pieces have been found to be out-of-tolerance. Electronic gages are preferred to air-electric control systems when the parts must be sorted into extremely fine categories for selective assembly.

In addition, the gaging equipment can be made to compensate for machine drift after a preset number of pieces have exceeded marginal limits within the tolerances. Indicating lights will show size classifications and provide visual warning when the machine has been stopped.

The basic equipment for electronic gaging includes an electronic gaging head which transmits a continuous signal whose amplitude varies directly with spindle displacement. Such a linear calibrated system is inherently capable of high amplification and exceptional accuracy.

Signals from the gaging head are fed to an electronic amplifier which provides linear amplification as well as rectification of the ac signal voltage into a dc signal for operation of a calibrated meter, signal lights, and classifier. The amplifier is capable of providing magnifications up to 15,000 times for use when extremely narrow tolerances are involved. Finally, an electronic classifier is used with the amplifier to control the sorting operation or to actuate relays for machine control. The electronic classifier can handle as many as 700 workpieces per minute.

For example, an electronic system controls a plunge-type centerless grinder in a finishing operation on glass pistons, *Fig*. 4. An electronic head gages the OD of the piston body through a pantograph-mounted contact, transmitting its signal through an amplifier and three classifiers. The gage checks the OD to tolerances of 0.0004 inch, and sorts the output into 20 acceptable classifications in steps of 0.000020 inch, in addition to oversized and undersized classes. As its control function, the gage stops the grinder after a preset number of unacceptable pieces have been gaged in succession.

Where an electronic unit is desirable but internal measurements are involved, it is quite likely that an air-electronic gage will be preferable. Air-electronic gaging is faster than air-electric gaging, and the system has the added advantage of being able to sort pieces into 20 or more size categories.

Air-electronic and electronic gages are similar, except that the former includes a transducer which transforms air-pressure variations into a continuous electronic signal of correspondingly changing amplitude. The third part in this series, to appear in a future issue, will cover combination in-process and post-process gaging systems.

What's Your Problem?

DO YOU HAVE a knotty problem in your automatic operations or those you plan to install? The AUTOMATION Problem Forum, a special feature department to be found in the rear of this issue, offers a unique service in which you will be interested.

To avail our readers of automation information and to tap the vast reservoir of practical know-how across industry, editorial space is devoted to the presentation of both problems and suggested solutions to the problems. This free exchange of ideas and information, as can be seen from the format of the Problem Forum, can be accomplished without violating the rights of privacy of individuals or firms. Why not take advantage of this service—what's your problem?

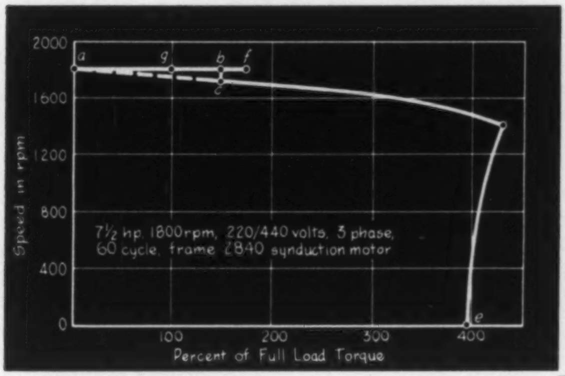
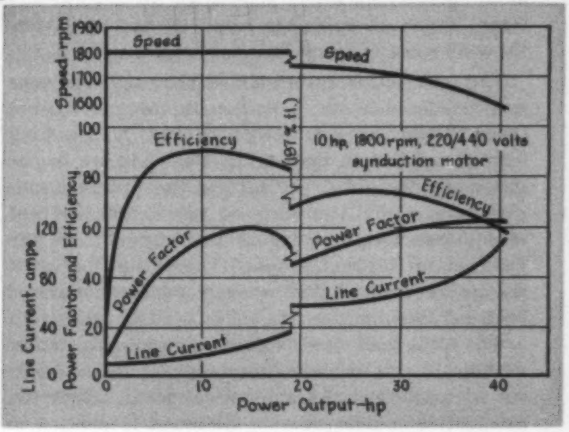
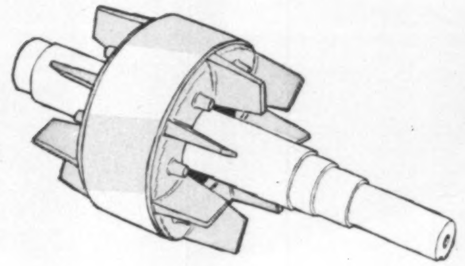


Fig. 1—Typical speed-torque curve showing starting point e, maximum torque point, and points c and b (pull-in torque) at which synchronous speed is attained. Synchronous speed is maintained between points a to f. Point c is dependent on connected load inertia.

Fig. 2—Motor performance curves based on results obtained from 10 hp four-pole machines operating on 440 volts.





SYNCHRONOUS SPEED DRIVE

With the introduction of the type of motor discussed in this article, there became available practical synchronous speed motors in the range between 10 and 40 horsepower. Highlighted are three main uses of this motor—constant speed, variable speed, and control system applications.

A LONGFELT NEED for synchronous speed motors that are rated less than 50 hp but combine relatively high efficiency with reasonable initial cost has been intensified by automation activity of the past several years. Combining squirrel-cage simplicity and ruggedness with constant speed regardless of load, the Synduction motor developed by Allis-Chalmers Mfg. Co. provides equipment designers and plant engineers working in the automation field with an entirely new approach to many drive problems.

Essentially an improved version of the reluctance type motor, this new motor attains synchronous speed without dc excitation. It has no slip rings, no brushes, no dc pole pieces and no rotor windings. The yoke, housings, bearings, and three-phase wound stator are similar to those of a standard squirrel cage induction motor.

Reluctance type motors which operate at synchronous speed without dc excitation have been built for many years, but poor power factors and efficiencies have ruled them out almost completely for ratings above 10 hp and have made them impractical for many applications requiring less than 10 hp. In contrast, efficiency and power-factor characteristics of the Synduction motor make it practical for drives requiring as much as 40 hp.

By unique slotting combinations in the rotor core, the efficiency of the Synduction motor has been raised to a point where it now compares favorably with the efficiencies of standard induction machines. Power factors are still somewhat below standard induction motors, but improvement over conventional reluctance designs has been considerable. TABLE 1 shows a comparison of typical motor performance characteristics for several different types of machines rated 20 hp, 1800 rpm, three-phase, and 60 cycles.

The Synduction motor builds up to synchronous speed much like an induction motor. A typical speed-torque curve is shown in *Fig.* 1. Starting torques applied to normal inertia loads are in the order of 350 to 550 per cent of the full-load running torque; pull-out torques, 160 to 200 per cent of full-load torque and pull-in torques, 110 to 140 per cent of full-load torque. The pull-in torque of the motor is dependent strictly on the connected load and load inertia.

When the load exceeds pull-out torque, the motor will operate as an induction motor, as indicated by its speed-torque characteristic curve. However, Synduction motors are not designed to operate in the range above pull-out or even near the pull-out point except for short intervals.

The motor will run at absolute synchronous speed so long as load does not exceed pull-out torque. Typical performance characteristics of efficiency, power factor, inrush current and speed versus power output are shown in *Fig.* 2. The motor is designed to tolerate variation in line voltage supply of plus or minus 10 per cent without changing speed under full-load conditions. The accuracy of the speed will be just as good as the accuracy of the frequency supply source.

▶ Constant-Speed Applications

There are several constant-speed applications in which the use of the Synduction motor rather than the previously used induction machine has resulted in improved performance of the driven equipment or improved quality of the end product. When it is used as the driving member for either 60 or 400-cycle motor-alternator sets, alternator output has shown improved characteristics. Since the speed of the drive motor is dependent strictly upon input frequency, the frequency output of the alternator is obviously no better than the frequency of the supply line. In this case, the reason for using a Synduction motor is to maintain constant voltage output, with constant load on the alternator terminals, despite varying voltage supply to the drive motor.

For example, since the Synduction motor runs at synchronous speed regardless of small variations in line voltage, the 60-cycle motor-alternator set acts as a line filter supplying a 60-cycle constant-voltage output from the alternator. An extremely stable power supply of this type is required by some sensitive electronic testing equipment which cannot tolerate the normal line voltage fluctuations obtained from a standard power supply.

These motors have been used in automatic or semiautomatic processes where a particular function must be synchronized with preceding and following operations. Many applications of this type are found in the food processing and packaging industries. One specific example is a meat-slicing machine drive. Despite load variations resulting from variations in the consistency of materials being processed, a Synduction motor driving the slicing machine maintains constant speed, enabling synchronization of the slicing operation with succeeding packaging and preceding operations.

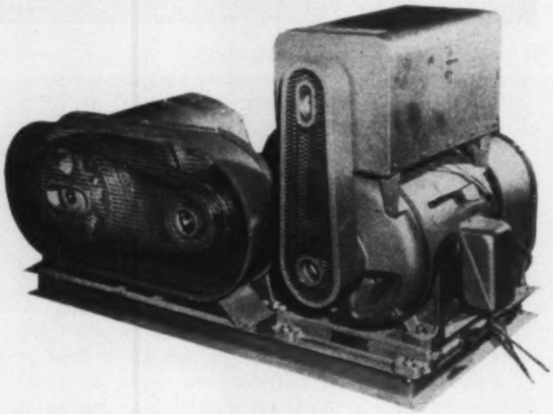


Fig. 3—Motor-generator set in which the Synduction motor element enables the set to produce high accuracy, variable frequency power for several Synduction drive motors. These drive motors will run at variable speed but in synchronism with each other.

Positive displacement metering pumps or proportioning units are logical applications for this synchronous machine. These operations normally require low power. When Synduction motors are applied, the output of the metering pump or proportioning unit is constant, regardless of changes in temperature which affect the viscosity of the liquid and therefore the load on the drive motor. Since drive motor speed is independent of load, the amount of liquid pumped remains constant.

These applications are representative of processes that require drives in the range of 1 to 40 hp and have the additional requirement that they must operate at synchronous speed regardless of the load imposed. Salient-pole synchronous machines in this horsepower range would normally be prohibitively expensive.

Variable-Speed Operation

Once a given machine is wound for a specific number of poles, its output speed depends strictly upon input frequency. By varying the input frequency to the motor, output speed can be varied and the motor will run at the synchronous speed for the frequency supplied, regardless of the load imposed upon the motor. Consequently, a range of precise speed settings that will be unaffected by the load on the machine can be obtained.

There are several means of obtaining variable frequencies. A salient-pole synchronous alternator driven at variable speeds will produce a variable-frequency output—so will a frequency converter unit with either constant or variable-frequency excitation, driven at variable speeds. Both of these methods have been used to obtain a variable-frequency source for Synduction motors.

Typical of applications requiring this type of variable-speed drive is one found in the synthetic textile industry. Because of the horsepower range and the extreme accuracies required in processing synthetic textile fibers, mechanical speed-changing devices often have been used. This textile process may require as many as 90 to 100 machines. Synchronization of all units in such a group must be maintained over a wide range of preset speeds. These requirements are satisfied by using Synduction drive motors at each of the 90 to 100 stations along the process line and supplying them from a single variable-frequency alternator, *Fig.* 3.

In applications of this type, drift or speed change after a given setting must not exceed plus or minus 0.1 per cent for steady-state load conditions over the entire range of speed settings. This high degree of accuracy is obtained by using a Synduction motor driving a variable-frequency salient-pole alternator through a suitable set of double motion control V-belt sheaves and fixed pitch drive sheaves.

Speed ranges as high as 15 to 1 have been obtained using this arrangement. However, this speed range is not obtainable without changes in the fixed pitch drive. A wide range drive which will give a 3 to 1 speed range without necessitating sheave changes while producing accuracies nearing plus or minus 0.1 per cent under steady-state load conditions is being developed. For applications requiring even wider ranges of speed, but not requiring this high degree of accuracy other types of mechanical speed-changing devices less restricting than the 3 to 1 speed range of V-belt drives can be used.

Component in a Control System

The Synduction motor is being used as a component in a system designed to control water-wheel generator speeds. In this control system, a permanent-magnet alternator is coupled directly to the shaft of the water-wheel generator. This permanent-magnet generator supplies a Synduction motor which in turn drives a flyball governor. The permanent-magnet generator, since it is coupled directly to the water-wheel generator, will produce a higher frequency than normal should the water-wheel generator tend to increase speed above that desired. This higher frequency is then fed to the Synduction motor driving the flyball governor, causing an increase in speed of the motor. The flyball governor in turn tends to close the inlet valve to the turbine runner, thus reducing the unit's speed.

Should turbine speed fall below the desired level, the permanent-magnet generator output frequency drops off, thus lowering the speed of the supported Synduction motor. This causes the flyball governor to open the valve controlling the flow of water to the turbine runner, thus increasing turbine speed to the desired level.

There are several problems involved in sizing the alternator and drive motor to support a Synduction motor. Since a Synduction motor requires

TABLE 1 - 20 hp, Four Pole, Three-Phase Motor Comparison

Performance Characteristics	Synchronous Motors		Synduction Motor	Squirrel Cage Induction Motor	Reluctance Motor
	100% PF	80% PF			
Efficiency, %	88	87	88	88	79
Power Factor, %	100	80**	60†	88†	38†
Pull-Out Torque, %	150	200	175	. . .	150
Pull-In Torque, %*	110	125	120	. . .	80-100
Locked-Rotor Torque, %	110	125	280	150	400
Locked Rotor Current % of Full Load amps	675	600	975	575	1050

**Lead   † Lag   *Based on 8 lb ft^2 load inertia high inrush current when starting on full voltage, the supporting alternator must be designed to handle the heavy inrush currents during the starting and accelerating period. In some cases, therefore, alternator sizes may seem large when compared to the supported equipment.

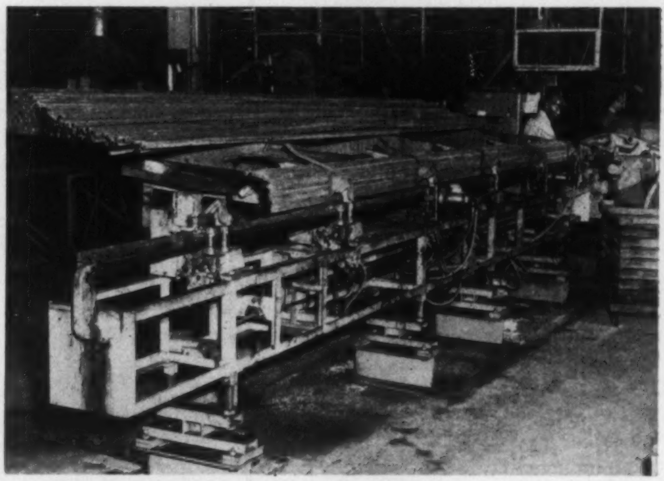
Where more than one Synduction motor is supported from a given alternator, this problem will be increased if all motors must be started simultaneously. The worst condition that will normally exist occurs when all motors but one are running at full load and the one remaining motor is started. In this case the alternator would have to maintain at least 85 per cent of rated terminal voltage during start-up of the final motor so that the motors already being supported from the alternator terminals would not pull out of synchronism.

To alleviate this problem during the start-up period, a unique closed loop method of starting the supported motors has been developed. In this procedure, it is not necessary to start the supported motors across the terminals of the alternator under full-voltage conditions. With all of the machines at rest, the supported motors tied directly to the output terminals on the alternators and the alternator fully excited, the main drive motor for the variable-frequency alternator is started. Under a set-up of this type the current drawn by the Synduction motors during the starting and accelerating periods never exceeds approximately 125 per cent of the normal rated full-load current. With this starting method the alternator can be sized more on the basis of supported motor full-load conditions than on the basis of supported motor inrush conditions. A separate source of dc excitation for the alternator fields is necessary.

Normally, the voltage applied to variable-frequency motors is supplied on the basis of constant volts per cycle; that is if at 60 cycles the voltage is 440v, at 30 cycles the voltage will be 220v. The lower limit of frequency operation is normally considered to be about 10 cycles per second and at these low frequencies the voltage supplied must be approximately 10 to 15 per cent higher than the normal constant volts per cycle.

Although recently introduced, the Synduction motor has already proved itself as a practical and economical drive for numerous applications. Because it combines constant speed regardless of load with squirrel-cage simplicity and ruggedness—in ratings for which no other synchronous motor is economically feasible—the motor is a vital factor in modern industrial applications.

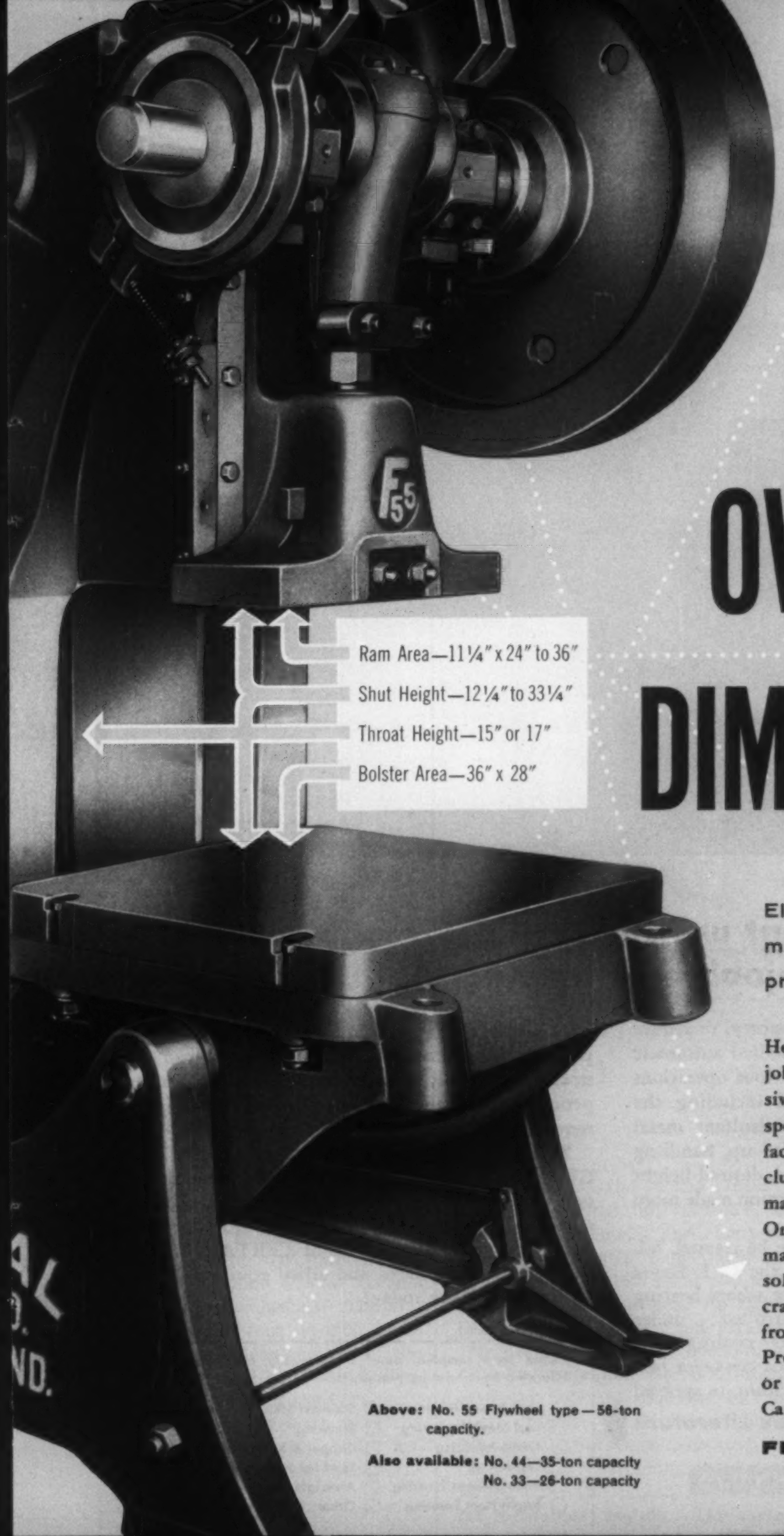
Automatic Feeder Speeds Bar Shearing



TO MEET the demand for producing parts more efficiently and at less cost, Michigan Div. of Thompson Products Inc. has installed a 20-foot Lipe-Rollway A.M.L. bar feeder in a shearing line for bar stock. Device automatically feeds 14-foot long hot rolled steel bars to an alligator shear. There, they are cut into lengths of 7 to 18 inches suitable for fabrication into 345 varieties of automotive steering links covering the needs of all the automakers.

Bundles of SAE 1040 steel, 5/8 to 1¾ inches in diameter, are delivered by overhead crane to a table behind the feeder. An operator clips the holding bands and bars roll by gravity into the magazine of the feeder unit. The pneumatically powered bar feeder then automatically feeds one bar after another to a stop behind the shear blade. Efficient operation is assured by scheduling runs according to bar diameter, keeping close sizes together irrespective of cutoff length. In this way, shutdown times for shear die changes are minimized. The bar feeder requires no changeover for bar diameters within its range.

New setup produces sheared bars at an average rate of 750 pieces per hour, which represents a production increase of 33 per cent over hand-feed method previously employed. In addition, downtime for loading has been eliminated.



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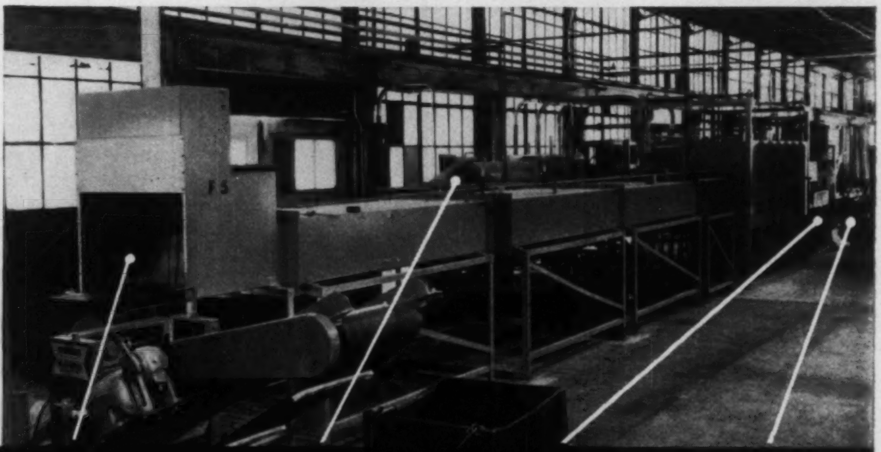
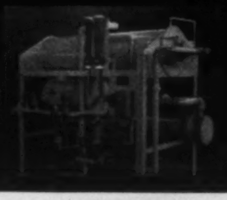
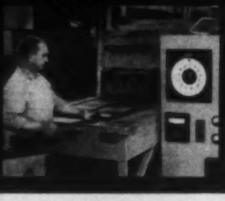


Treated Products being Discharged



Hayes Atmosphere Generator



Control Equipment at Loading End of Furnace

Types of Products Treated

C. I. Hayes equipment ups the profit potential of another modern jobbing stamping plant!!

Worcester Pressed Steel Company, to reduce annealing cycle costs, recently installed automatic C. I. Hayes equipment. Many previous operations have been completely eliminated including the *messy pickling* process with its resultant metal losses. Production has been speeded up, handling time cut down, spoilage minimized, desired bright finish obtained, and the entire operation made more profitable.

At the Worcester plant, work to be treated, following wash process, is fed into the C. I. Hayes belt conveyor type electric furnace where heating and cooling cycles are precisely controlled . . . under protective atmospheres. Work, after cooling automatically, is then transferred onto a conveyor belt type coater where a film of lubricant is sprayed onto stampings. Parts come out of this machine properly lubricated (in a dry state) and can be stored indefinitely without rusting . . . or can be processed through any subsequent operations required.

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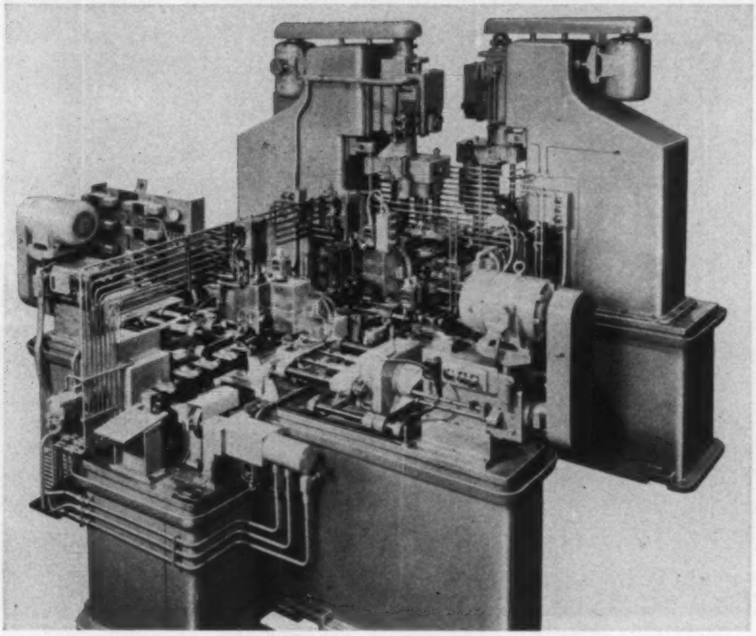
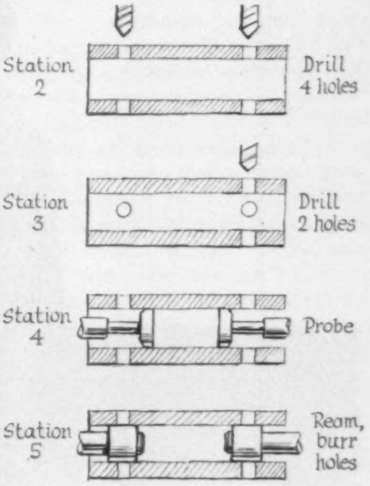
new equipment

Machines and plant equipment for more automatic operations

For detailed information and literature, use card page 17.





Conveyor Type Transfer Machine

DOUBLE load six-station transfer unit has been designed by **Crescent Tool & Machine Co., Inc.,** 25125 W. Outer Dr., Melvindale, Mich., to machine second turbine shafts for transmissions. The machine can drill four 1/8-inch holes equally spaced near one end of the hollow shaft and drill two 0.0938-inch holes, 180 degrees radially displaced, in spline teeth near the other end of the part. Holes are deburred inside with floating-center reamers.

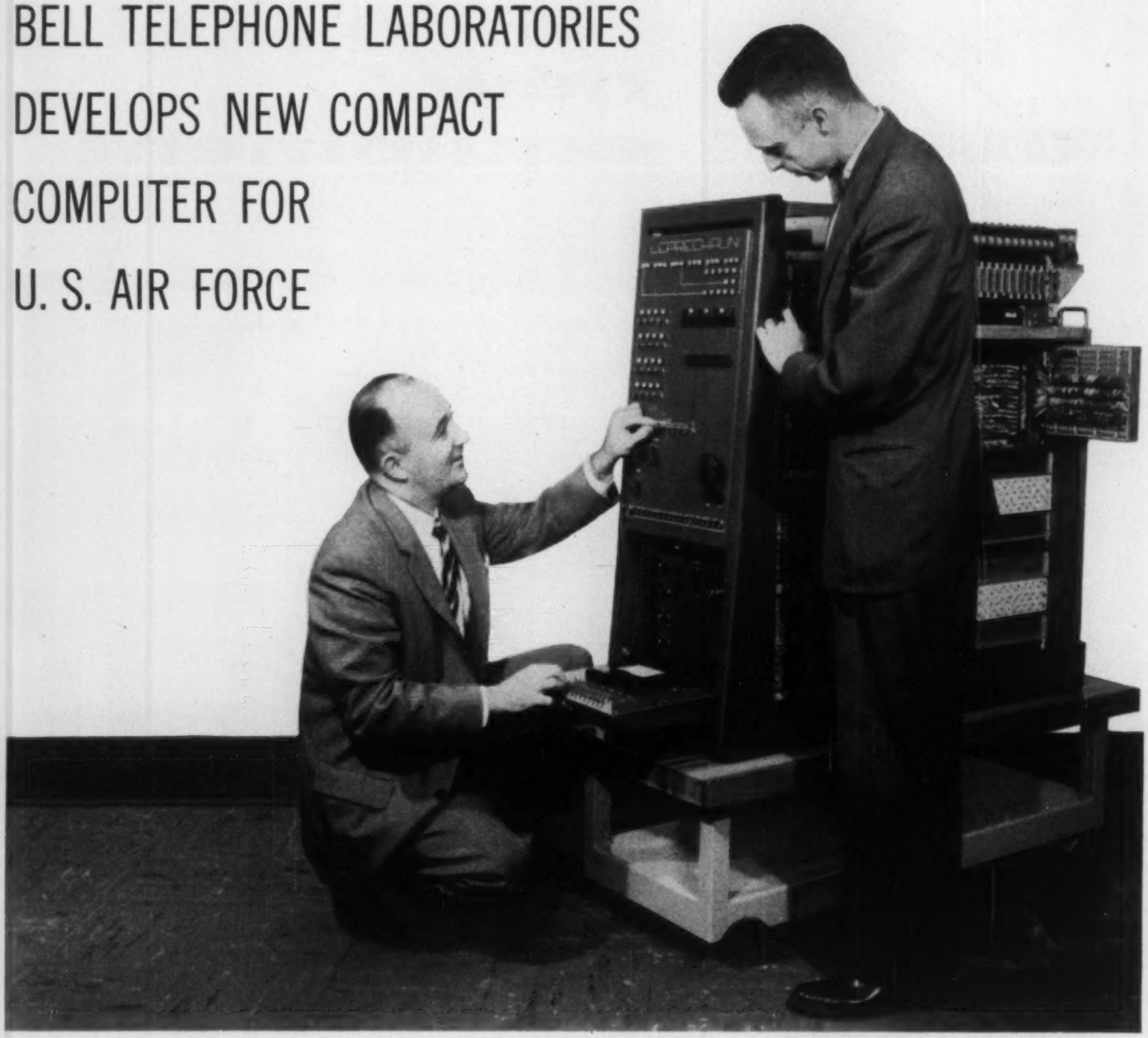
Operation Sequence

In operation, two parts are loaded in the first station on a platen chain-drive conveyor type transfer mechanism. At the second station, parts are picked up, rotated 180 degrees for location, and clamped. Each part is drilled 0.0938-inch diameter near its left hand end and 0.125-inch diameter near its right hand end. Part is then rotated 180 degrees and one 0.0938-inch diameter hole and one 0.125-inch diameter hole are produced in the shaft opposite the first two holes. The part is unclamped, rotated 90 degrees for positioning, and released onto the platen for transfer to the next station. The parts are picked up and rotated 180 degrees for location at the third station, clamped, and each part drilled 0.125 inch in diameter near the right hand end. Part is rotated 180 degrees and drilled 0.125 inch in diameter again. The parts are then unclamped and lowered onto the platen and transferred to the fourth station where each end is probed to check for broken drills from the previous drilling stations. At the fifth station, parts are clamped and deburred to remove burrs left from drill breakthrough at the drilling stations. The parts are then unloaded. Production rate is 288 pieces per hour.

Machine is a "building block" design. Platens which carry the part through the machine tool operations are fixed to alloy steel chain lengths. The assembly is hydraulically indexed for approximate positioning at the work stations. Conveyor type transfer is continuous and allows use of any type of fixturing required. The part is always returned to the platen fixture that brings it to any station.

Circle 401 on Page 17

BELL TELEPHONE LABORATORIES DEVELOPS NEW COMPACT COMPUTER FOR U. S. AIR FORCE



J. A. Githens, B.S. in E.E., Drexel Institute of Technology, and J. A. Baird, Ph.D. in E.E., Texas A. & M., check the control panel of Leprechaun, a new high-speed computer which solves extremely complex problems in one-tenth of a second. Small size and low power are made possible by new design principles and Bell Laboratories' invention of the transistor.

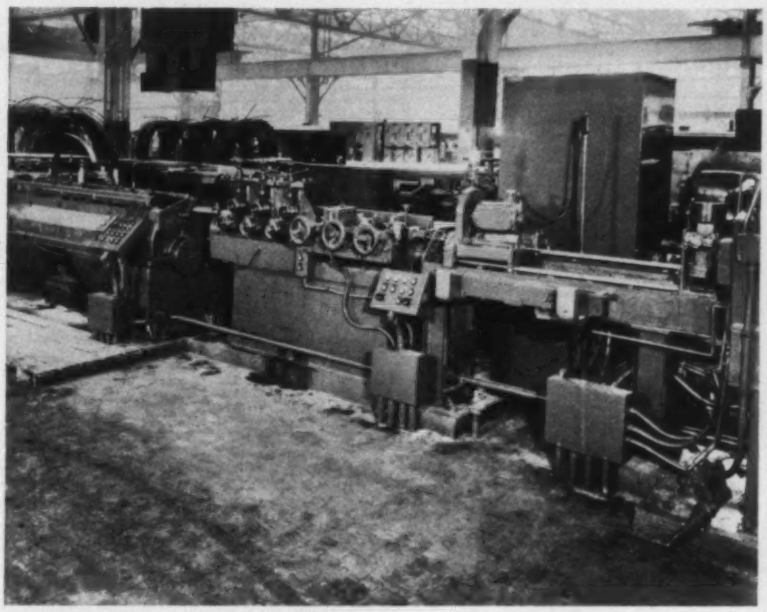
The United States Air Force assigned Bell Labs an interesting assignment: develop a new kind of electronic computer. The major requirement was greater simplicity. Of course, no computer is simple, but this one (known as "Leprechaun" to its designers) is much smaller and simpler than most of the computers currently in use.

It has only some 9000 electrical components; 5000 of them are transistors. As a result, Leprechaun has less than one-third the components of conventional computers. This facilitates testing, experimentation, assembly and service.

Even in its experimental state, Leprechaun is a stimulating example of great strides in the simplification and miniaturization of circuitry . . . a problem of profound interest to all Bell Laboratories researchers as they develop radically new equipment for your future telephone service.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT



Automatic Tube Processing Line

Item 402

A TUBE processing line suited for use by the nonferrous industry for the finishing of copper, brass, and aluminum tubing has been designed by **Loma Mfg. Co. Inc.,** 114 E. 32nd St., New York 16, N. Y. The material can be finish-drawn, straightened, cut to length, and recoiled directly from long coils of stock at a high production rate. The line includes an uncoiler, a draw bench, a roller straightener, a flying cut-off, an automatic discharge conveyor, and a recoiler.

The drawbench can be eliminated if finish-drawn stock is obtained from the bull block. The recoiler can be eliminated if straight lengths are being produced. All components in the operation are interlocked mechanically and electrically in one integrated line controlled by one operator. This line has been installed at **Chase Brass & Copper Co.,** Cleveland, Ohio.

Operational Details

The multiple drawbench is 400 ft long, 10 ft high. It draws 5 tubes simultaneously from an initial length of 43 ft to straight lengths up to 210 ft in sizes of ¾ to 2 inches in diameter. The circular inverted drawing block machine takes straight lengths of tubes up to 210 ft long from the drawbench and redraws them to greater lengths of smaller diameters. Coils, 60 to 65 inches in diameter, containing from 500 to 3000 ft of tube depending on final tube diameter, are produced. An automatic drawing, straightening, and cutting to length or recoiling machine converts the large coils into finished straight lengths or longer coils. It automatically performs a series of operations that make the 60 to 65 inch diameter coils—containing up to 3000 ft of tube from the circular inverted draw blocks—into straight lengths or coils of tube of the size and type specified. A vapor degreaser is capable of degreasing whole bundles of tubes up to 30 ft in length. Internal and external defects are detected, marked, and the faulty tube ejected by an automatic electronic defect detector.

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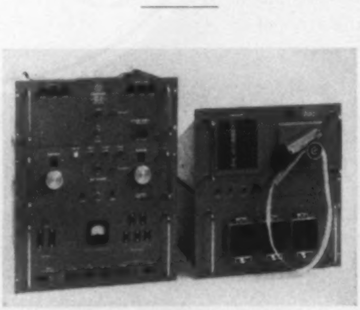


Circuit Tester

Item 403

Machine performs complex tape-controlled measurements on electronic and electrical equipment. Production and maintenance tests, including measurements of impedance, ac and dc voltage, resistance, leakage, and continuity are performed on a *go/no-go* basis according to the sequence, value, and tolerance information punched into a standard 1-inch tape. Model 180 can be programmed to energize equipment under test, provide warm-up delay periods, stop when the operator performs a manual operation, and can be supplied with an accessory printer to provide a permanent test record.

Two test points designated on the tape are selected from 300 test leads by a crossbar switching unit for each measurement. A parallel arrangement provides the selection of four or more test points at a time; two used for measurement, and the others used for operations such as controlling relays or providing signal voltages to the unit under test. Bridges are used to compare the circuit under test to standards selected from four precision decades located within the tester. Accuracies of the bridges are ±1 per cent for impedance and ac voltage, ±½ per cent for resistance and dc voltage. Ranges are: impedance, 10 ohms to 1 megohm; resistance, 10 ohms to 10 megohms; dc voltage, 1v to 1000v; ac voltage, 2.5v to 750v; continuity, 0.5 ohms with 100 ma test current; leakage, 10 megohms to 500 megohms with 100, 250, or 500v dc applied. **California Technical Industries, div. of Textron Inc.,** 1415 Old County Rd., Belmont, Calif.

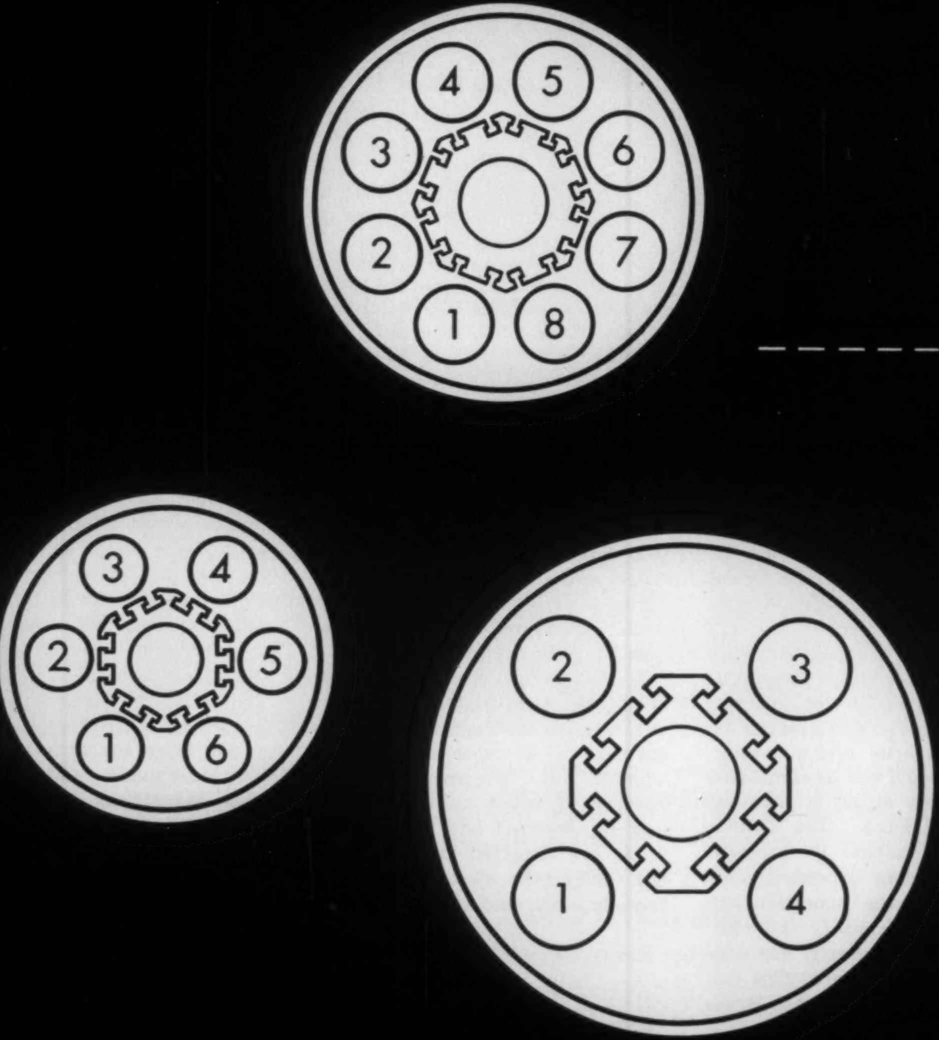
Circle 403 on Page 17

Chemical Analyser

Item 404

Device consists of two separate units. The chemical unit contains an array of glass vessels controlled by automatically operated taps. The electronic control unit determines the precise sequence of operations performed by the chemical unit. The analyser is connected to the main plant stream, and at regular intervals a measured quantity of the solution being manufactured is fed to a reaction vessel. After dilution with water, titration with a standard reagent

a message to production-minded engineers with automated equipment in mind



These multiple-spindle diagrams are symbols of one of the earliest, simplest, and yet most efficient forms of automation the world has yet known. They represent circumferential automation, a design principle embodied in the development of the first automatic screw machine, built in 1893 by National Acme and inherent in all Acme-Gridleys since then.

don't overlook the advantages of

circumferential automation*

* Think of each spindle on an Acme-Gridley multiple-spindle automatic as a work station, and you will quickly see that here, too, is automation . . . *circumferential* automation. Here, as in all forms of automation, pre-sequenced operations are *performed in succession—and without manual attention*—to save time and cut costs in many ways.

Actually, circumferential automation goes all other forms one step better; rather than requiring a line of machines and transfer arrangements, Acme-Gridley's speedy, compact spindle arrangement *saves floor space, machine investment and man hours.*

Admittedly, multiple spindle operation is not the answer to all machining problems. Today however, production men are taking a closer look to be sure they are missing no bets. They cannot afford to be wrong tomorrow.

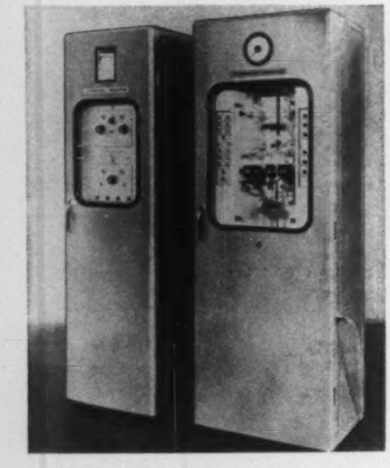
Is there a place for *circumferential* automation in *your* operation? Let us help you find out.

National Acme

THE NATIONAL ACME COMPANY, 196 E. 131ST ST., CLEVELAND 8, OHIO • Sales Offices: Newark 2, N. J., Chicago 6, Ill., Detroit 27, Mich.

builders of the world's only complete line of
multiple-spindle, bar and chucking automatics

Circle 678 on Page 17



begins and continues until the solution has been completely neutralized. The amount of reagent used is determined by a photocell which finds the level of the reagent and records the volume used on a recorder chart. Any variations in the plant stream can be detected instantly, and corrective measures applied. Unit was developed by Electronic Instruments Ltd., and the Billingham Div. of I.C.I. **Instrument Div., Robertshaw-Fulton Controls Co.,** 2920 N. Fourth St., Philadelphia 33, Pa.

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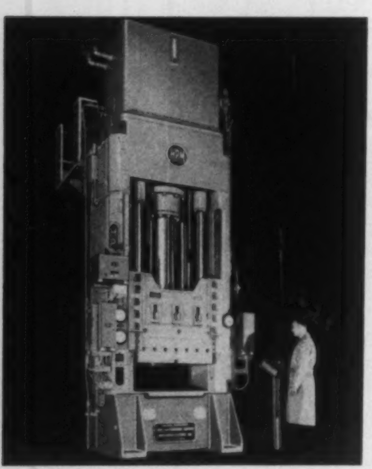

Hydraulic Press

Item 405

Suitable for use on equipment for metal forming operations, hydraulic press is equipped with a safety device that provides an 18-inch curtain of light across the front pressing area. When this curtain of light is interrupted a signal is sent to the press control circuit, which de-energizes the electrical controls and automatically sets the hydraulic pump on reverse stroke. The slide is then lifted to the starting position at the top of its stroke and the press stops. The next cycle cannot be started until both forward buttons are depressed by the operator. Press has a 56 inch daylight opening and the main slide stroke is 36 inches. Closing speed is 720 inches per min; pressing speed 75 inches per min, adjustable down to $7\frac{1}{2}$ inches per min. **Hydraulic Press Mfg. Co., div. of Koehring Co.,** Mount Gilead, Ohio.

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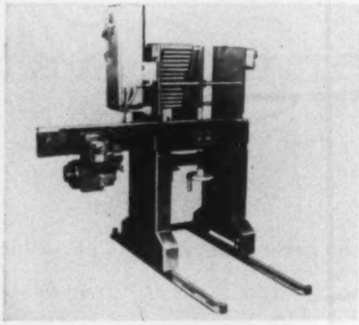

Magazine Loader

Item 406

Unit is designed for feeding long bars or tubing into centerless grinders, polishing machines, and heat treating equipment. Parts are loaded into the Model 8000 hopper, where they are cycled by an automatic switch, escapement, and agitator mechanism to a steel conveyor belt which delivers the parts to the production machine. Hopper is adjustable to permit handling parts $\frac{1}{4}$-inch to $2\frac{1}{4}$-inches in diameter, and 3 to 24 inches in length, and permits loading up to 2200 $\frac{1}{4}$-inch diameter pieces.

Conveyor has a variable speed drive which controls cycling rate and permits conveyor speeds ranging from 5 to 20 fpm. A handwheel adjusts the magazine and conveyor height. Additional flexibility is provided by the *V*-track mounting of the unit which facilitates lining up the production machine or moving the unit out of the way when changing grinding wheels. A floor lock assures rigid positioning of the unit when in operation. **Production Feeders Corp.,** 3130 Johnnycake Ridge Rd., Mentor, Ohio.

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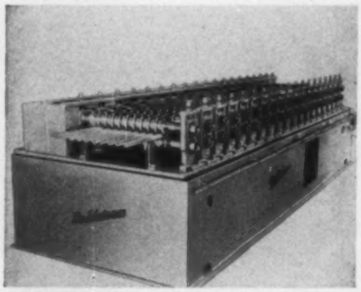

Roll Forming Machine

Item 407

Device is adaptable for corrugating galvanized steel, aluminized steel, plain and embossed aluminum. It can handle gages of material from 20 through 28. Gage range is controlled by a vertical adjustment. Roll shafts are mounted on antifriction bearings, and operating speed is 150 fpm. Roller die tooling is available for $\frac{1}{2}$ or $\frac{7}{8}$-inch depth with control of coverage and depth. Machine is available as an individual unit for feeding sheets (shown); with a decoiling and shearing line conveying cut lengths into forming machine; or as a complete roll-forming line accepting coil stock and forming and cutting to length. **Dahlstrom Machine Works Inc.,** 4227 W. Belmont Ave., Chicago 41, Ill.

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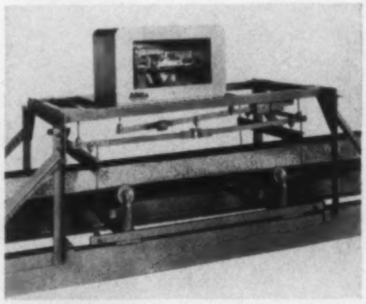
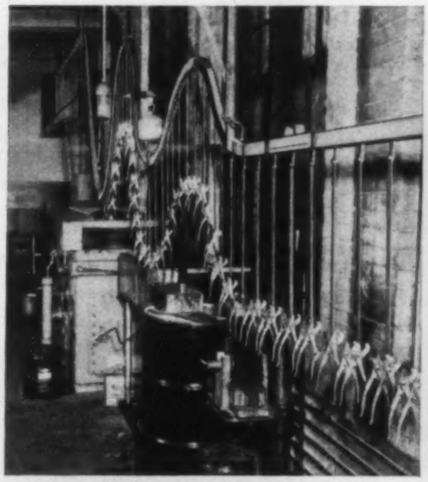


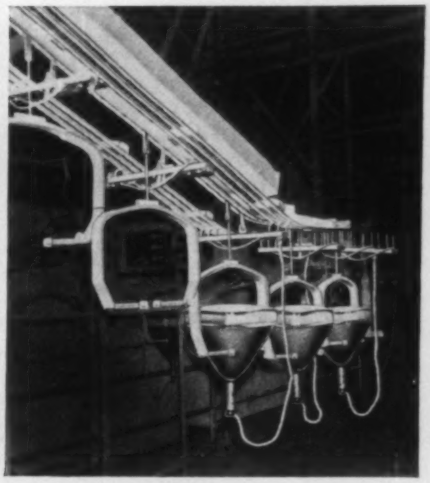
Belt Conveyor Scale

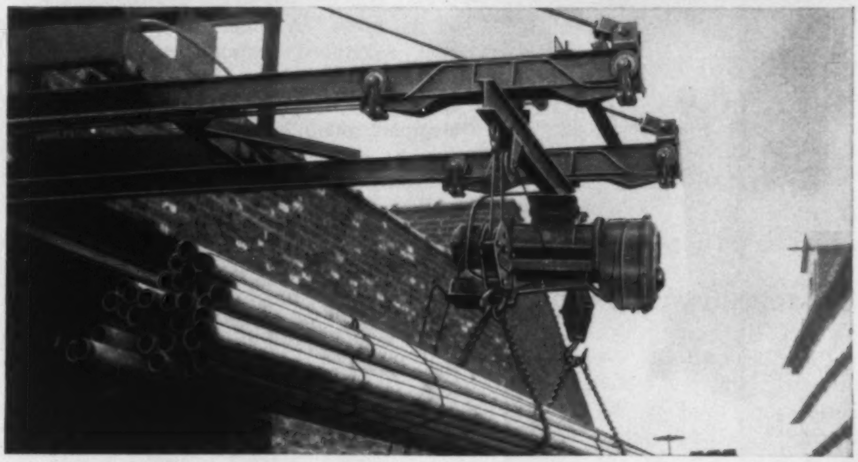
Item 408

Unit is capable of weighing, controlling, and totalizing free-flowing bulk materials. Belt scale is built

From pliers to tv-tubes to heavy steel...







R-W OVERHEAD CONVEYOR SYSTEMS PROVIDE PRODUCTION FLEXIBILITY AND EFFICIENCY FOR REAL "PROFIT-IMPROVEMENT!"

Whatever it is you want to convey, from trays of minute component parts to individual units weighing up to 6 tons, it can be handled swiftly, safely and efficiently by an R-W Overhead Conveying System. From economical standard units to very complicated Automatic-Selective Conveyor Systems, engineered from economical standard components, there's an R-W Conveying System designed to solve your exact materials handling problem. Individual R-W Conveyor Systems offer the following outstanding advantages; provides a steady flow of parts to production work stations for a fast, controlled production rate ... stores parts in "out-of-the-way" overhead storage banks and automatically releases them as desired ... releases valuable floor area for additional production facilities ... engineered to reduce overhead costs and increase production efficiency. All of the above advantages are very important factors in helping your firm realize a much desired "profit-improvement." R-W Conveyors are economical to install and maintain ... each is engineered and manufactured to provide years of dependable operation with maximum efficiency, economy and flexibility. Your nearby R-W Sales Engineer will appreciate the opportunity of demonstrating how an R-W Conveyor System will solve your specific materials handling problem ... call him today!

R-W "460" "Zig-Zag" TWIN-TRAK OVER-WAY TRU-TRED

Conveyors to meet your exact requirements!

The Overhead Conveying Systems engineered and manufactured by Richards-Wilcox, a leader in this field for over 50 years, have earned an enviable reputation for dependable, trouble-free operation. Complete data on each type of R-W Conveying System is covered in the following catalogs. Write today for the catalogs you desire.

- **#2035 "ZIG-ZAG" CONTINUOUS POWER CHAIN CONVEYORS ... Catalog No. A-93-R.**
- **R-W "TWIN-TRAK" OVERHEAD AUTOMATIC DISPATCH SYSTEMS ... Catalog No. F-192.**
- **#460 LIGHTWEIGHT POWER CHAIN CONVEYORS ... Catalog No. A-96-R.**
- **"TRU-TRED" CONVEYOR EQUIPMENT ... Catalog No. A-64.**
- **TROLLEY TRACK CONVEYING EQUIPMENT ... Catalog No. A-82-R.**
- **"SAFE-RAIL" CONVEYOR EQUIPMENT ... Catalog No. 94-R.**

Richards-Wilcox
MANUFACTURING COMPANY
"MATERIAL HANDLING DIVISION"

RICHARDS-WILCOX R-W AURORA, ILL.

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Circle 679 on Page 17

to an accuracy of 1 per cent of flow over entire weight range. Three-quarter size window in scale housing allows easy access for setting, routine checking, and maintenance. A gear box drive incorporates sealed-for-life bearings, and a self-cleaning *V*-rail construction is used for the integrator mechanism. **ABC Scale Div., McDowell Co. Inc.,** 16300 Waterloo Rd., Cleveland 10, Ohio.

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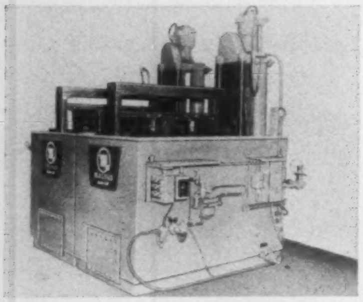

Cylinder Head Cleaner

Item 409

Unit automatically removes all dirt and chips from cylinder heads. Heads are rolled on the cleaning machine platform from a plant roller conveyor and are held in position by an adjustable hold-down device. A press on the *Start* button causes the platform to lower into the cleaning solution where it immediately starts its fast cycle of vertical agitation. The rotating device is energized, causing the carrier platform and heads to revolve during the fast up and down vertical agitation.

The combined motion of the cylinder heads in the cleaning solution scrubs all interior and exterior surfaces. As the position of internal oil lines, recesses, and cavities of the parts are constantly changed by the combined rotary and vertical motion, chips and other solid dirts are washed to the outside of the parts and fall to the bottom of the tank away from the parts. At the end of the cleaning cycle, the platform automatically rises to the top of the tank where it rotates a few additional turns to drain all interior recesses. **Equipment Div., Magnus Chemical Co. Inc.,** Garwood, N. J.

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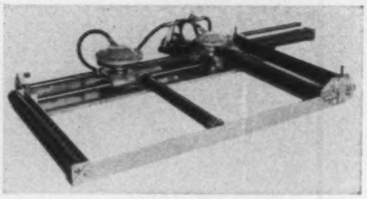

Air Feed/Stock Leveller

Item 410

Device is capable of feeding high finish coiled materials such as stainless steel, aluminum, plastics, etc., to punch presses. It is designed for direct mounting to a bracket mounted on the side of the press. Stock is fed on the upstroke of the press. A roller cam valve that is tripped by some moving part of the ram or die is also mounted to the press. Nylon stock clamping anvils on the gripper assembly clamp the stock with a pressure of approximately 1600 lb, and carry the stock forward with a push of the feed cylinder of approximately 300 lb. Stock is pulled through the light duty stock levellers which remove coil bend from light gage material up to 0.090 inch thick. **Special Engineering Service Inc.,** 8161 Livernois Ave., Detroit 4, Mich.

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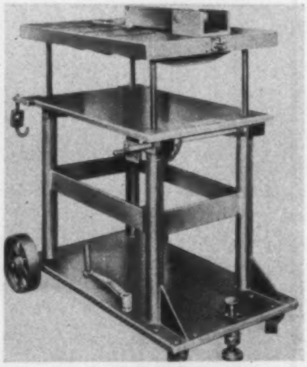

Die Transfer Table

Item 411

Designed for transporting dies from storage to press, portable elevating table is also suitable for general lifting, moving, and maintenance work in shops and stores. Unit has eight recessed, free-rolling conveyor rollers and a ram, impelled by a screw and nut device, which travels the length of the top-plate, pushing loads from table to press or storage shelf, and pulling loads from press or storage shelf to table.

Vertical movement of the top-plate is 25 inches starting from 35 inches minimum and extending to 60 inches maximum above floor level. Leverage is exerted through a worm, worm gear, and screw device. Floor lock and two turnbuckle hooks prevent movement of table during loading and unloading. **Hamilton Tool Co.,** 9th St. & Hanover, Hamilton, Ohio.

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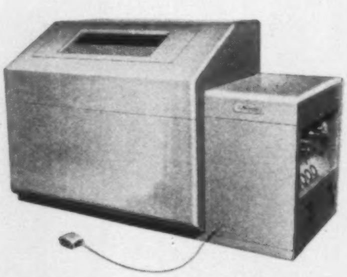

Spray-Mask Painting Unit

Item 412

Machine is adaptable to simple or difficult spray-mask painting problems involving workpieces of various sizes, shapes, and surface conditions. Model BS-6M has quick adjustment for any size area within the machine's dimensions. A single adjustment at each end of the desired stroke automatically controls both the length of the stroke, and the spray gun *on* and *off,* eliminating overrun on small parts, saving production time and paint.

Spray gun can be positioned at any angle and distance from the work, and the angle is adjustable from zero to 15 degrees in each direction. The gun carriage mechanism is ball bearing mounted, traveling on a ball screw drive for smooth and uniform control. Lubrication is powered by air pressure, and is automatic while machine is operating. Pneumatic operation provides flexible and accurate control of speed of travel, amount of finishing material, spray gun pattern, and cycling. **Sepanski & Associates,** 900 Clancy Ave. N. E., Grand Rapids, Mich.

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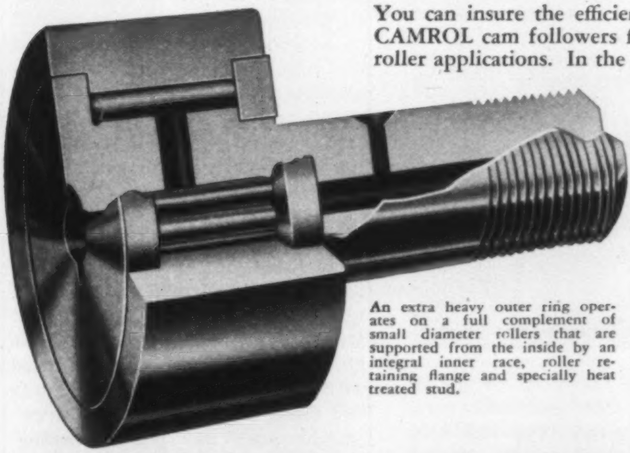
AUTOMATION TIPS by McGill

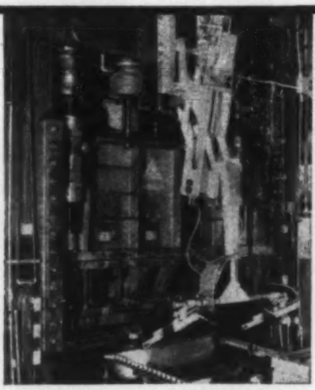
Insist on CAMROL® bearing advantages when planning your automation



An extra heavy outer ring operates on a full complement of small diameter rollers that are supported from the inside by an integral inner race, roller retaining flange and specially heat treated stud.

You can insure the efficiency of your automated production by specifying CAMROL cam followers for cam action, track roller or guide and support roller applications. In the machinery you specify or in your own automated operations, CAMROL bearing quality guarantees dependability and longer bearing life. Their ability to withstand intermittent shock and heavy radial loads, space economy, ease of installation, simplified lubrication and balanced hardness and toughness recommends CAMROL cam followers for the critical anti-friction requirements of automation. You can eliminate downtime due to premature failures of improvised units or ordinary bearings.

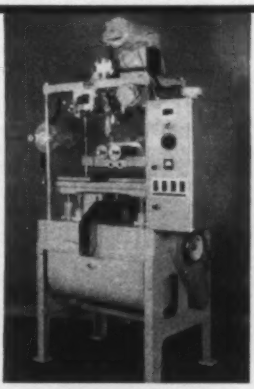
Insist on CAMROL CF or CYR (without stud) bearings. Both types are available in a wide range of standard sizes as are the sealed SCF and SCYR series.



Camrol bearings eliminate bearing trouble for Sahlin iron hand unloaders.

Sealed CAMROL SCF bearings on the upper arm assembly travel a confined cam track to provide direction and support for the unloading arm. Here the IRON HAND machine is shown removing 120 lb. bathtub blanks from a forming press onto a conveyor for additional automatic operations. The Sahlin Engineering Co., Inc. that supplies this unique press unloader to automate press operations, adopting CAMROL cam followers, has virtually eliminated bearing replacement under all conditions.

SEND FOR CATALOG 52-A



Camrol bearings show no apparent wear after three years use in automatic packaging machines.

The Kartridg-Pak Machine Co. uses McGill CAMROL bearings in the main drive mechanism of a packaging machine that also forms the container from thermoplastic film. This machine automatically forms, fills and closes 1800 packages of food or other semi-fluid products per hour. Dependability and accuracy of the free rolling and easily lubricated cam followers help guarantee the efficiency of these automatic operations.

After three years of use in this application, the CAMROL bearings show no apparent wear.

Camrol bearings assure greater speed and accuracy in shear-speed shapers.

Michigan Tool Co. uses CAMROL CF and CYR bearings in Shear-Speed Shapers that automatically produce gears up to 20 inches in diameter and up to 6 inch widths in only 13 minutes. These bearings, acting as cam followers, accurately control the feed of all cutting tools simultaneously and relieve these tools from the work on return strokes. They insure dependable, precision performance for automatic operations at high production speeds in these largest production gear cutting machines ever built.

***Insure performance with* McGILL®**

MULTIROL® GUIDEROL® CAMROL

Precision Needle Bearings

McGILL MANUFACTURING COMPANY, INC., 401 N. LAFAYETTE ST., VALPARAISO, INDIANA

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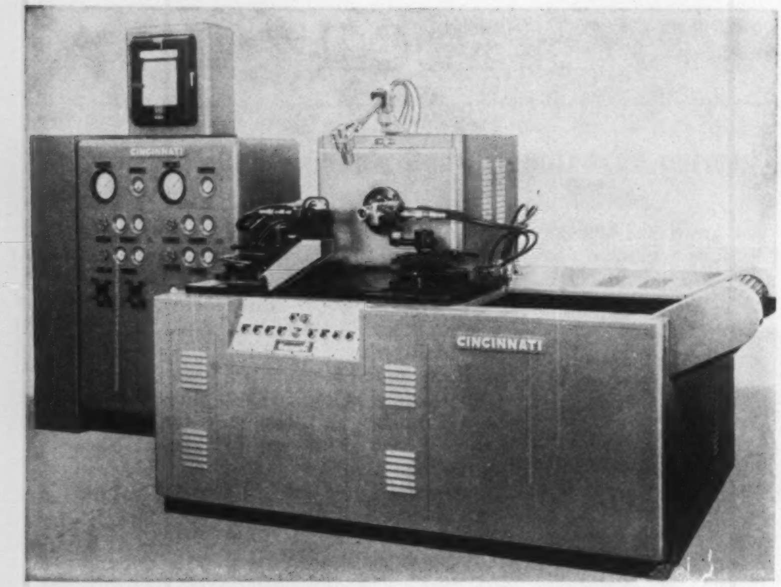

Flame Heating Machine

Item 413

Machine is designed for heat processing applications requiring high or low heating capacity, selective application of heat, precise temperature control, and automatic operation. The base, which houses the quench tank and heat exchanger, an automatic quench agitation system, and a work removal conveyor, also acts as a support for numerous work-holding fixtures and flame heads. The conveyor can be timed to work continuously or intermittently with each heating cycle, allowing delivery to be integrated with plant conveyor systems.

The rear portion of the base houses a mechanical controls compartment for the work-handling fixtures. Pushbutton controls for all machine functions are located on a control panel on the front of the base. Flame heads with removable tips are used with the rotating spindle work unit. Heads are mounted on pneumatically-actuated sliding mounts with 4-inch retraction for each head. An electronic temperature control automatically terminates the heating cycle, and drops the workpiece into the quench tank when its surface temperature reaches the desired preset value. The machine base and control cabinet can be used with other work-handling units and flame heads for various applications such as spot hardening, combination hardening, and brazing. **Process Machinery Div., Cincinnati Milling Machine Co.,** Cincinnati 9, Ohio.

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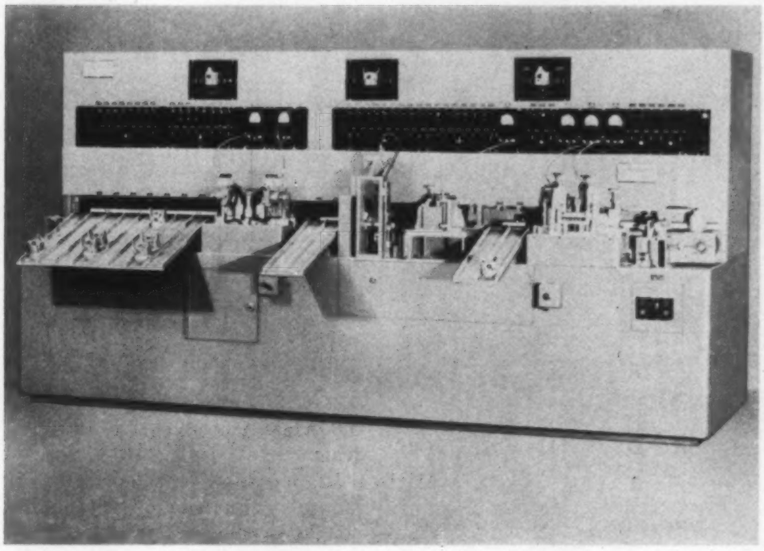


Piston Inspection Machine

Item 414

Four-station electronic inspection machine automatically feeds, gages, and segregates automotive engine pistons. Unit inspects piston pin holes for alignment, distance of bored holes to piston face, outside diameter for dimensional size between predetermined points, bore diameter, and automatically prints proper size definition on the piston face. Production rate is 1800 parts per hour.

Each station of the machine is controlled individually by an electronic cybernetic system. It controls the flow of parts from station-to-station, and action in and out of each station, detecting improperly positioned parts. Machine can readjust itself and even out the flow if either an excess or too few parts are fed to it. Gage heads which operate on a reflected wave circuit using a frequency of 30,000,000 cps, are used to check piston dimensions. A plug-in design is used in the electronic circuit. The circuit is divided into packaged units which can be easily removed for fast inspection or replacement. **Arlin Products Inc.**, 13541 Auburn Ave., Detroit 23, Mich.

Circle 414 on Page 17

Breaker-Conveyor

Item 415

Unit is designed to handle all semifriable bulk materials from ½ to 5 inches thickness, and is capable of crushing up to 100 tons of solidified chemicals per hour. Materials are crushed and delivered to storage silos in one operation. Unit consists of a chemical breaker

Westinghouse CYPAK takes the "mix up" out of cake mix storage conveyors

Chelsea Milling Company, maker of well-known "Jiffy" brand premixed foods, uses flexible Cypak* static control to reduce materials-handling costs at its plant in Chelsea, Mich.

Starting at the mixing and packaging machines, Cypak control memorizes the sequence of cartons going to the warehouse . . . maintains carton identification automatically . . . directs storage according to the preselected pattern. In addition, Cypak predetermines subsequent delivery to the loading dock.

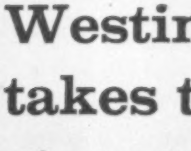
Result: substantial savings have been realized through reduced handling and carton breakage.

For complete information on Cypak, call your Westinghouse representative. Or, write Westinghouse Electric Corporation, 3 Gateway Center, P.O. Box 868, Pittsburgh 30, Pennsylvania.

J-22094

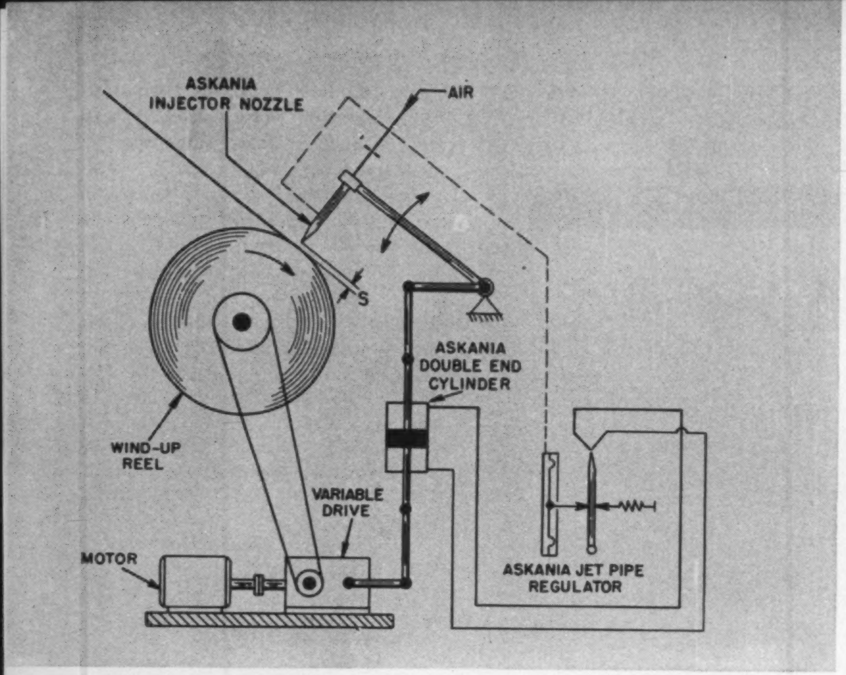
*Trade-Mark

POWER-UP starts with CONTROL



YOU CAN BE SURE...IF IT'S Westinghouse

Circle 681 on Page 17

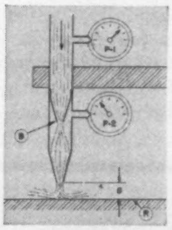


If Your Problem is to Control Winding and Unwinding Speed— as the Diameter Changes

THIS ASKANIA FOLLOW-UP SERVO SYSTEM IS THE SOLUTION

This diagram shows the operation of an Askania Follow-Up Servo System used for controlling winding and unwinding speed—*as the diameter changes.*

In this application the distance (s) constitutes a measure of the spool diameter and the variable drive is automatically adjusted to change winding speed in accord with the changing diameter of the spool...as it winds or as it unwinds. *There is no physical contact* with the surface...thus the surface of the wire or material being wound cannot be marred or injured.



INJECTOR NOZZLE

Sensing element of the system is the unique patented Askania Injector Nozzle which provides a pressure signal to the Askania Jet Pipe Controller.

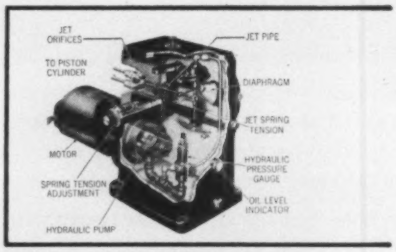
HAVE OTHER CONTROL PROBLEMS?

A host of similar industrial control problems are being solved with similar Askania Servos using Jet Pipe Controllers. Do your problems include any of these:

- Three dimensional positioning
- Maintenance of constant distance between tool and work
- Cam or pattern following
- Linear follow-up of synchro positions
- Other types of tool or material positioning

Write for Application Bulletin

For information on winding or unwinding roll speed control...or any other Askania control system...write Askania Regulator Company, 244 E. Ontario Street, Chicago, Illinois.



ASKANIA JET PIPE CONTROLLER

Askania Jet Pipe Controller translates the pressure signals from the injector nozzle into corrective action by way of the Askania double end cylinder.

ASKANIA REGULATOR COMPANY

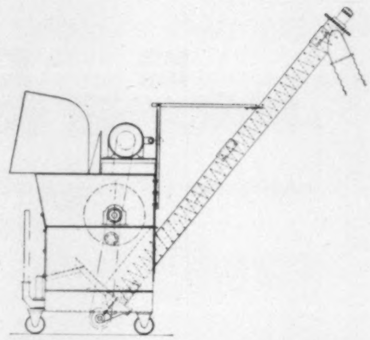
"CONTROLS FOR INDUSTRY"

Hydraulic, Electrohydraulic and Electronic Controls—
Valve Actuators and Cylinders—General System Engineering

A SUBSIDIARY OF
GENERAL PRECISION EQUIPMENT CORPORATION

GPE

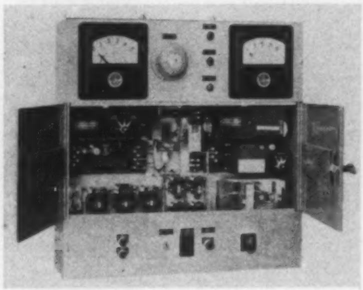
Circle 689 on Page 17



and a screw conveyor driven by the same motor as the breaker drum.

In operation, chemical cake is fed into the breaker through a hopper opening. The cake drops onto a revolving drum strung with lines of steel spikes that pass between teeth of an adjustable steel comb-plate attached to the walls of the breaker. As the drum turns, particles fall through the openings between the drum and the teeth of the comb, and out the bottom of the breaker. The small pieces then move to the screw conveyor which consists of a half pitch screw enclosed in a tube. The material passes through a delivery opening at the top of the conveyor and into a flexible connector. **Gifford-Wood Co.**, Hudson, N. Y.

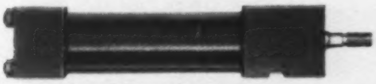
Circle 415 on Page 17

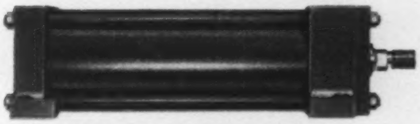


Panel Control Cabinet

Item 416

Unit is designed to group primary burner controls, burner safety devices, gages, fuses, circuit breakers, and signals in one cabinet. Top and bottom gage and circuit breaker panels can be removed for easy access to terminals. Piano-hinged doors are secured by a key lock handle. Cabinet is available in three sizes. It can be



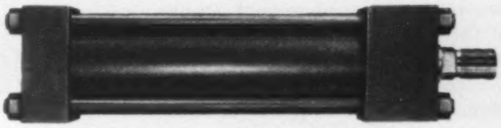


Five cylinder series...
each the best of its kind!

Here you see one more reason why experienced cylinder users prefer Hannifin cylinders...there is a Hannifin cylinder series for every type of service.

What pictures cannot show you is the extra effort that goes into every Hannifin cylinder, all the way from the drawing board to the shipping dock. This brings you design features other cylinders simply do not have...superior workmanship where it's most needed for long, trouble-free service...and better delivery promises, better kept. All at prices no higher than you may have been paying for less satisfactory cylinders.

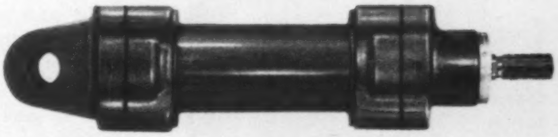
There's a Hannifin man near you—or, if the need is urgent, call us long distance. He or we will welcome the opportunity to help you as you select the Hannifin cylinder series that best meets your needs.



AIR AND HYDRAULIC

HANNIFIN

POWER CYLINDERS



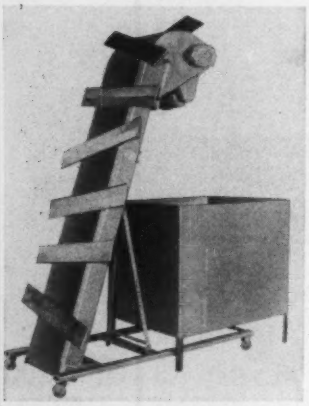
COMPLETE CYLINDER FILE

Write for your copy of this new Hannifin Cylinder File... complete, easy-to-use, easy-to-order-from information on five lines of Hannifin cylinders. Write Hannifin Company, 541 S. Wolf Road, Des Plaines, Illinois.

HANNIFIN
Power CYLINDERS

used alone, or in "building block" combinations. It can be mounted on the wall, on a pedestal, a base, or on the floor. **Cleveland Fuel Equipment Co.,** 1111 Brookpark Rd., Cleveland 9, Ohio.

Circle 416 on Page 17

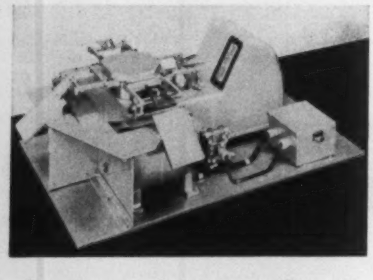


Magnetic Conveyor

Item 417

Applicable on an automatic production line, conveyor uses permanent magnetic equipment and can handle all ferrous materials, stampings, machined parts, scrap, nuts, bolts, and caps. It can be elevated to 90 degrees. Nylon guides ride in a track in the conveyor bedplate providing proper alignment. Design of the magnetic bed allows objects wider than the conveyor to be moved without spillage. **Bosworth Mfg. Co.,** Mills Rd., Avon, Ohio.

Circle 417 on Page 17

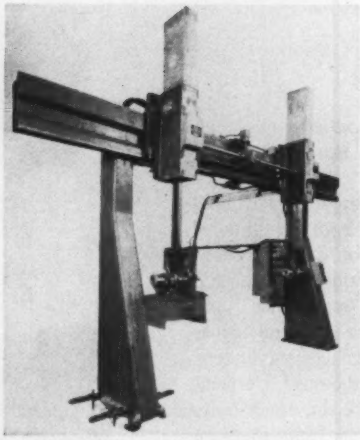


Checkweighing Machine

Item 418

Instrument is capable of proving weight accuracies in the range of one part in 5000 up to one part in 20,000. Model 144 has a rotary transfer mechanism with one loading station, one weighing station, and two discharge stations. An automatic transfer device places the product on and removes it from the scale with a minimum of impact. The weighing device has a sensitive, even lever balance scale. Accurate weight is provided by the use of counterweights on the scale weight platter. A visual weight reading dial with an antifriction optical light indicating system is included. A printed circuit transistor amplifier is used in the control system, which also includes direct reading crystal photocells on adjustable mountings. Unit can operate at speeds up to 30 weighings per minute. Accessories available are recorders, counters, and visual and audible signaling devices. **Exact Weight Scale Co.,** Columbus 8, Ohio.

Circle 418 on Page 17



Loading/Unloading Unit

Item 419

Device can be used to automate standard grinders in transferring work to and from each grinder. The transfer unit includes complete hydraulic and electrical equipment, and is tied into a grinder by a terminal for synchronized operation. In operation, each of two stations lowers to pick up the work, raises and transfers the work across and down into the grinding or unloading area. Cycle time is about 15 seconds. The unit is designed to straddle the grinder being serviced, with a loading and unloading station at each side, allowing two automatic conveyor lines to be added. **Machine Tool Div., Wickes Corp.,** 515 N. Washington, Saginaw, Mich.

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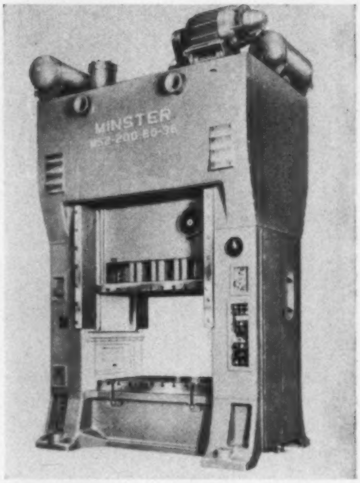


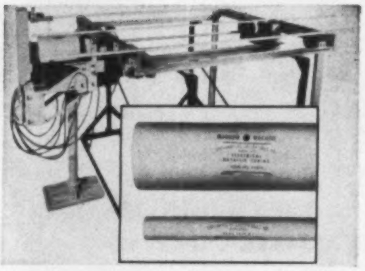
Straight Side Press

Item 420

Higher single stroke efficiency and continuous press speed are features of Model MS2. Air friction clutch and brake drive arrangement allows faster starting and stopping with more single stroke operations per minute.

Clutch and brake unit is located on a slower turning intermediate shaft. The faster speed of a conventional single geared machine or the slower speed of a double geared press is offered. Recirculating oil lubrication system provides a continuous oil film on all bearing surfaces. Presses are available in capacities from 150 to 500 tons. **Minster Machine Co.,** Minster, Ohio

Circle 420 on Page 17



Tube Marking Unit

Item 421

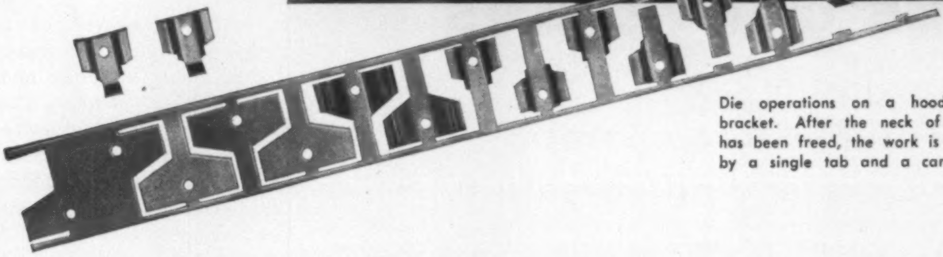
Machine marks information such as product name, trademark, and grade on electrical metallic tubing and marks other long, tubular parts and products as desired. Model 86A accepts tubes with di-

BETTER CARS ARE BEING BUILT

New

Henry & Wright
Double-Crank
Dieing Machines
Produce More
Parts Faster . . .
More Accurately

150 ton Henry & Wright, one of ten installed by a leading automobile manufacturer in the Flint area.



Die operations on a hood bumper bracket. After the neck of the part has been freed, the work is advanced by a single tab and a carrier strip.

Stamped parts of today's cars must be produced rapidly and in quantity, but they must also be held to close tolerances of accuracy. Henry & Wright machines are now offered in a new double-crank design. The crosshead is supported on both sides of the die so that the tools close in perfect alignment even with severe off-center loads. Thus, parts are more accurate and uniform . . . die life is greatly extended. Because machine design permits quick and easy die change, non-productive time is reduced to a minimum.

Handling more jobs—faster—and to required accuracy tolerances—makes the H & W machines an integral part of automation processes for any plant. These machines are truly the result of "pooled ideas" from the automotive field and from experienced H & W engineers.

Send today, for complete information on these new and proven production profit makers. Build your new production around Henry & Wrights—they're made by H-P-M, you know, a leader in metalworking processes since 1877.

HW

H-804

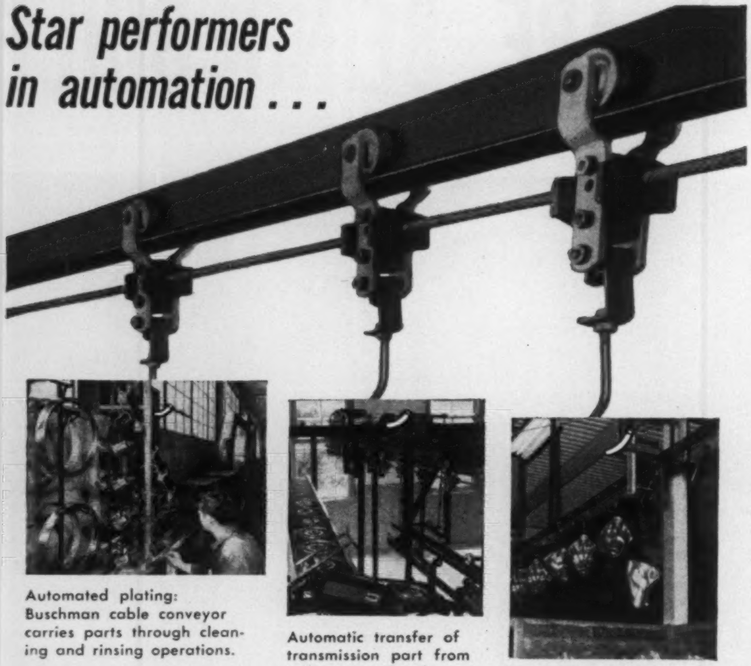
THE HYDRAULIC PRESS MFG. COMPANY

A DIVISION OF KOEHRING COMPANY • MOUNT GILEAD, OHIO, U.S.A.

HPM

Circle 684 on Page 17

Star performers
in automation . . .



Automated plating: Buschman cable conveyor carries parts through cleaning and rinsing operations.

Automatic transfer of transmission part from roller to overhead cable conveyor.

Truck axle housings automatically discharged by types and sizes at pre-selected locations.

BUSCHMAN
CABLE CONVEYORS

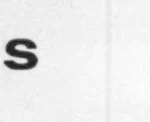
★ Low initial cost
★ Trouble-free operation
★ Outstanding versatility

. . . long have made Buschman "Universal" Cable Conveyors industry's first choice for everyday transportation of light and medium loads.

Today . . . for the same reasons . . . industry specifies Buschman Cable Conveyors for automated and semi-automated applications. Buschman facilities include the creative engineering "know-how" to design and produce such auxiliary equipment as dispatch and control centers . . . power-and-free in-process inventory control . . . automatic pickup, discharge and transfer equipment . . . and repositioning devices.

Whether your problem involves automation or dependable everyday transportation, investigate the savings possible with Buschman. Remember . . . *when low-cost production is your goal . . , Buschman is your conveyor.* The E. W. Buschman Co., 4551 Clifton Avenue, Cincinnati 32, Ohio.

Write today for literature.

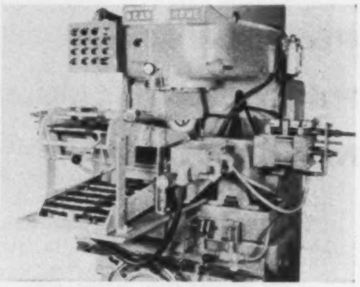


C-328-EWB

WORLD'S MOST COMPLETE LINE OF CONVEYING EQUIPMENT
BUSCHMAN
CONVEYORS

ameters from ½ inch to 4 inches in standard 10 ft lengths, plain or coated, and prints up to 30 pieces per minute, depending on the conduit size. Maximum imprint area is 1¾ inches along the longitudinal axis of the tube, and 2 inches from top to bottom circumferentially around the tube. Device can be used as an automatic in-line unit, or as a separate manually controlled machine. **Markem Machine Co.,** Keene 77, N. H.

Circle 421 on Page 17



Automatic Loader

Item 422

Device is capable of handling long-shaft, unsymmetrical gears on tooth honing machines and rotary gear shaving machines. The loader has a built-in gaging device, magazine feed, air-powered rocker type loading mechanism, and a discharge chute that feeds finish-honed parts to unloading position in front of the operator. Lever-type grip fingers in the input magazine and discharge chute keep the gears from touching each other and prevent the cocking of parts.

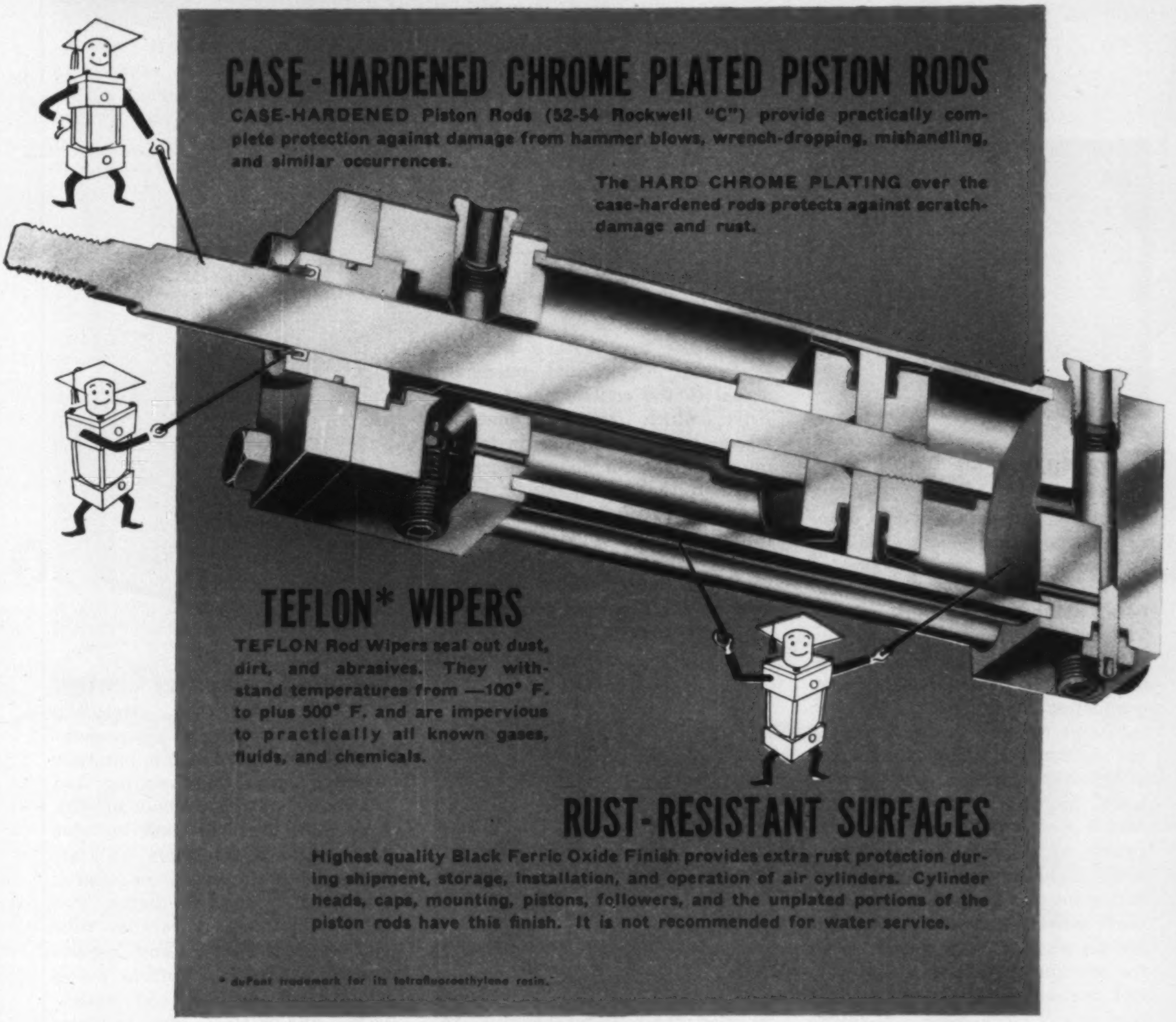
In operation, the input magazine is filled with long-shaft gears, and the operator presses the *Cycle Start* button. The rocker mechanism picks up a gear at the end of the magazine and rolls it into mesh with the honing tool. The rocker automatically retracts and remeshes the gear with the honing tool if the first meshing is incorrect. The air-operated head and tailstocks automatically advance to support the work gear, and the honing cycle is started. While the gear is being honed, the rocker retracts to loading position where another gear drops into position. When the gear is honed, it is automatically unloaded by the rocker

Circle 635 on Page 17

At No Extra Cost . . .

AIR CYLINDERS

with EXTRA QUALITY Features!



CASE-HARDENED CHROME PLATED PISTON RODS

CASE-HARDENED Piston Rods (52-54 Rockwell "C") provide practically complete protection against damage from hammer blows, wrench-dropping, mishandling, and similar occurrences.

The HARD CHROME PLATING over the case-hardened rods protects against scratch-damage and rust.

TEFLON* WIPERS

TEFLON Rod Wipers seal out dust, dirt, and abrasives. They withstand temperatures from —100° F. to plus 500° F. and are impervious to practically all known gases, fluids, and chemicals.

RUST-RESISTANT SURFACES

Highest quality Black Ferric Oxide Finish provides extra rust protection during shipment, storage, installation, and operation of air cylinders. Cylinder heads, caps, mounting, pistons, followers, and the unplated portions of the piston rods have this finish. It is not recommended for water service.

---

* duPont trademark for its tetrafluoroethylene resin.

Other Standard Miller Quality Features include: bar stock steel heads, caps, and mountings; rust-resistant brass barrels; self-regulating, wear-compensating piston rod seals that never require adjustment; space-saving square design; and other features as shown in Bulletin A-105 sent free on request.

Sales and Service from Coast to Coast . . .

Miller
AIR CYLINDERS
Meet J.I.C. Pneumatic Standards
No Broken Castings, No Scratch-Damage to Piston Rods, Bushings and Seals . . . therefore
NO COSTLY DOWNTIME . . . NO REPAIRS . . .
NO MAINTENANCE . . . NO POWER WASTAGE!

Miller Air Cylinders are available in 1½" through 20" bores for 250 psi operation. Select from 19 standard mountings, strokes up to 22 feet, single and double rod end, cushioned and non-cushioned, and over-size rod cylinders. Large selection for immediate delivery.

Circle 686 on Page 17

MILLER FLUID POWER
DIVISION OF FLICK-REEDY CORPORATION
2015 N. HAWTHORNE, MELROSE PARK, ILL.

AIR & HYDRAULIC CYLINDERS • BOOSTERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS

mechanism and the next gear is rolled into mesh with the honing tool. Lever-type fingers in the input magazine and discharge chute pivot as each gear passes over them. Weight of a gear causes individual levers at each shaft end to rock down, preventing adjacent gears from touching each other. **National Broach & Machine Co.,** 5600 St. Jean Ave., Detroit 13, Mich.

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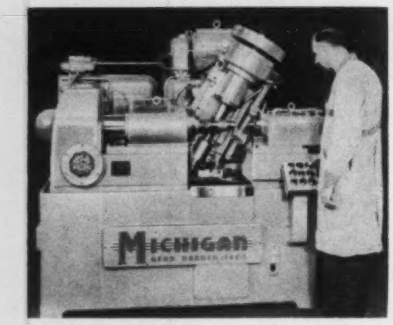

Gear Hobber

Item 423

Suitable for installation in automated gear lines, Model 1458-B, a horizontal single-spindle machine has an 8-inch center distance between hob arbor and work spindle. The entire hobbing cycle is fully automatic, with the machine returning to the loading position upon completion of the part. The hob is plunge fed into the work by a Z bar mechanism. The plunge feed is infinitely variable from zero to 0.800 inch, is hydraulically operated and controlled. The work-spindle assembly is mounted on a dovetail slide, has a recess 23 inches deep for positioning long-shaft gears. Accessories available are an automatic expansion arbor for workholding, and a size control device which adapts to the Z bar infeed mechanism. **Michigan Tool Co.,** 7171 E. McNichols Rd., Detroit 12, Mich.

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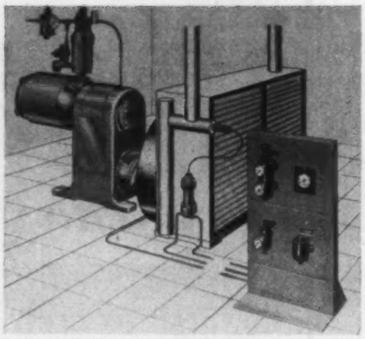

Temperature Controller

Item 424

System provides controlled variable speed for fans or pumps in heat exchange processes. Unit includes a temperature sensing transmitter and a control panel. System can be used with heat exchanger systems operating at pressures up to 1000 psi, and can hold the desired product output temperature within 1 per cent of the desired value. Temperature transmitter supplies the required input signal for the control panel. A gas filled bulb in the transmitter senses the temperature and generates a proportional pneumatic signal to the control on the Varidrive, which slows it down or speeds it up, depending on the required correction. This alters the speed of the driven fan or pump. The temperature bulb of the transmitter is constructed of stainless steel, permitting its use in a wide variety of media. **U. S. Electrical Motors Inc.,** Box 2058 Terminal Annex, Los Angeles 54, Calif.

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Magnetic Belt Conveyor

Item 425

Conveyor is capable of transporting ferrous loads, or steel tote boxes, either unpackaged or in paperboard containers, at angles up to 90 degrees. Loads are carried on a thin, rough surface belt which slides over a metal bed containing permanent Alnico magnets. The like poles of all magnets are connected with metal strips. The magnetic attraction of the continuous metal strips holds the load securely on the belt, which carries it up or down. A positive acting drive consisting of a right angle gearhead motor with a roller chain drive to the conveyor headshaft was designed for the belt to conform to the lower vertical curve. **Alvey-Ferguson Co.,** 1711 Disney St., Cincinnati 9, Ohio.

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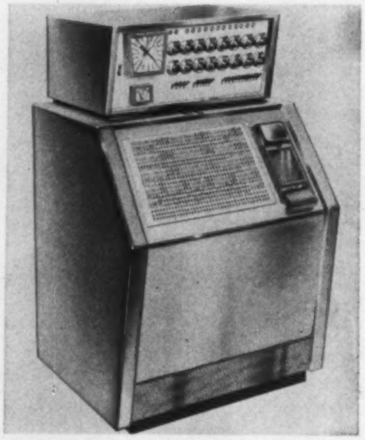


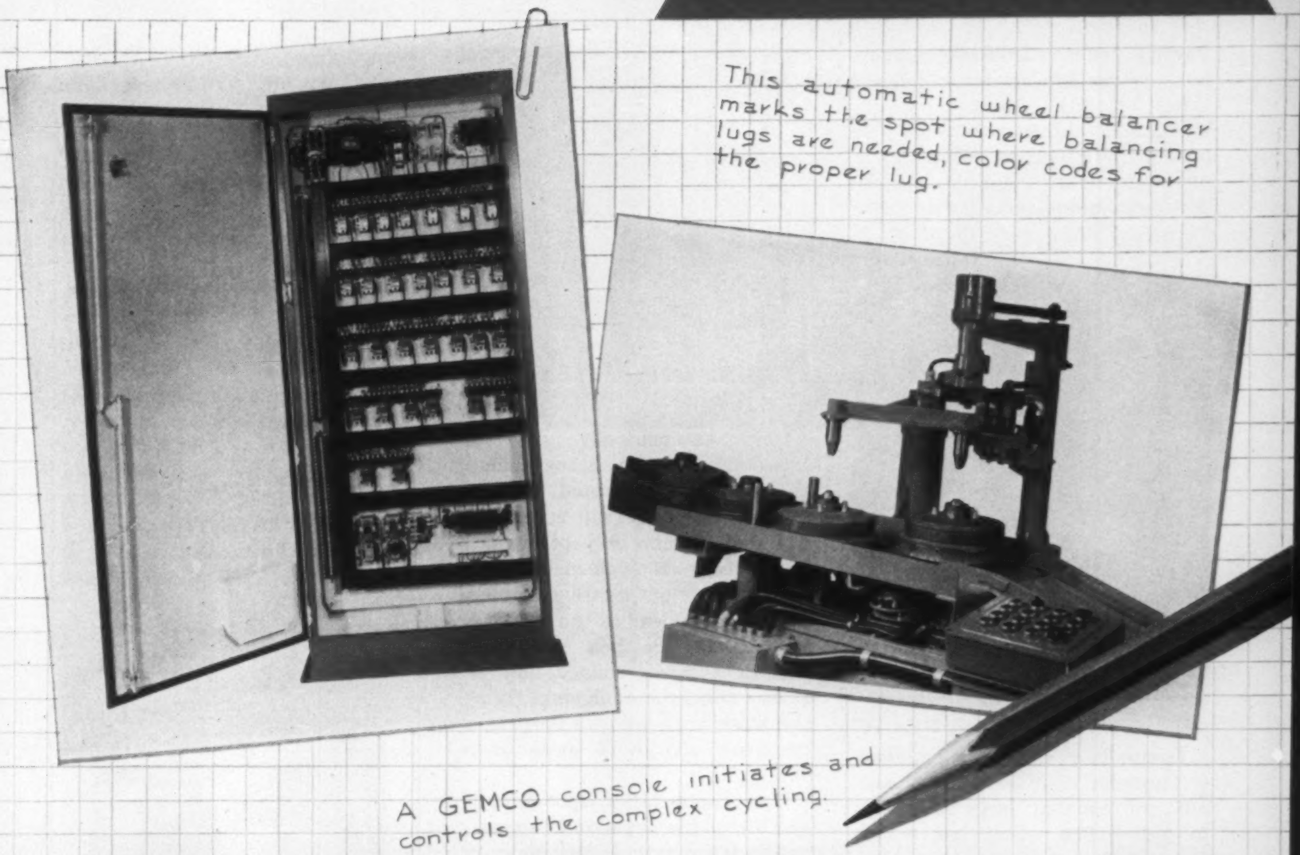
Portable Computer Center

Item 426

Unit is applicable in such operations as heat exchangers, catalytic cracking, proportional mixing, and automatic controls. Model MC-400, a portable desk side unit includes 12 operational amplifiers, 16 scale factor potentiometers, one servo multiplier, four free diodes, two relay amplifiers, a vacuum tube voltmeter, a two channel oscillographic recorder, a built-in power supply, full monitor and control panel, and a fixed type program patchboard.

The network design eliminates the need for compensation due to changing capacitive load, varying feedback resistance, and variation of input frequency. Feedback to the amplifiers can be varied from 100 megohms to zero and the amplifiers will still remain stable. An overload alarm system, both visual and aural, goes into action when the amplifiers are operating non-

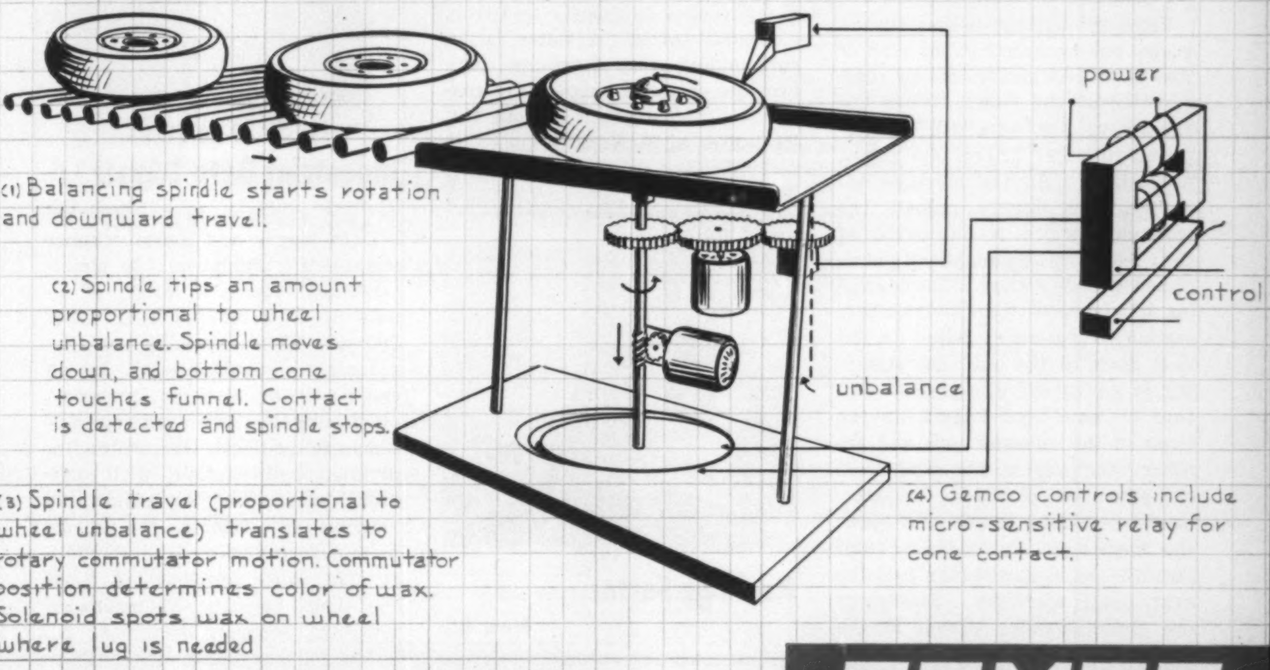
AUTOMATIC CONTROL IDEAS



This automatic wheel balancer marks the spot where balancing lugs are needed, color codes for the proper lug.

A GEMCO console initiates and controls the complex cycling.

LOCATES & MEASURES WHEEL UNBALANCE



(1) Balancing spindle starts rotation and downward travel.

(2) Spindle tips an amount proportional to wheel unbalance. Spindle moves down, and bottom cone touches funnel. Contact is detected and spindle stops.

(3) Spindle travel (proportional to wheel unbalance) translates to rotary commutator motion. Commutator position determines color of wax. Solenoid spots wax on wheel where lug is needed

(4) Gemco controls include micro-sensitive relay for cone contact.

Whatever your control problem, it's well handled at Gemco. Write, wire or phone today.

Circle 687 on Page 17

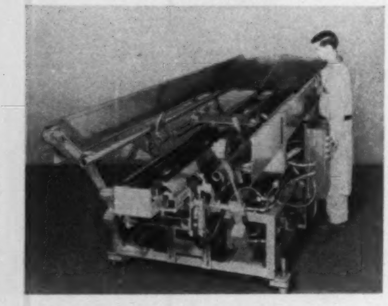
GEMCO

CUSTOM CONTROLS

GEMCO ELECTRIC COMPANY
25681 W. 8 Mile Rd. • Detroit 19, Mich.

linearly, regardless of voltage output. Tube life is increased by tying together output tube filaments and cathodes through use of individual filament transformers on each dual amplifier chassis. **Mid-Century Instrumatic Corp.**, 611 Broadway, New York 12, N. Y.

Circle 426 on Page 17



Transfer Device

Item 427

Device is a combination unloader, transfer, and feeder unit suitable for handling large stampings in pressrooms. Unit has a carriage that travels back and forth on horizontal slides. Power for driving the carriage is supplied by a reversible air or electric motor through roller chain drives.

Transfer mechanism has an unloader unit mounted at the rear of the carriage, and a loader unit mounted at the front. When the die lifters are actuated, rubber-tipped unloader fingers are raised to position. As the carriage advances, the fingers unload the stamping, which is supported at the rear by automatically-positioned rubber rollers. The stamping is advanced to an intermediate station on stationary rails. On the next cycle of the unit, the stamping is advanced to a preload station by pawl-type fingers on the front of the unloader unit and another stamping is unloaded from the press and placed in the intermediate station. On the next cycle, the fingers on the unloader unit advance the first stamping into the next press operation. Stampings are simultaneously placed in the intermediate and unload positions by the unloader unit. **Press Automation Systems Inc.**, 25418 Ryan Rd., Centerline, Mich.

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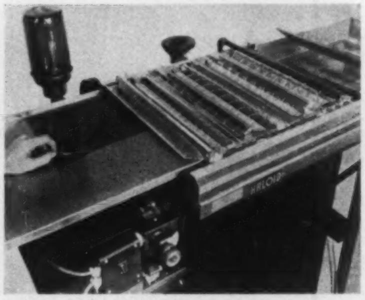


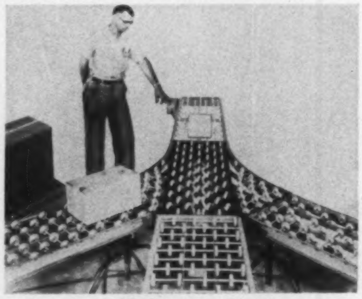
Graphic Arts Developer

Item 428

Unit automatically develops, fixes, and washes lithographic—size cut-sheet film and negative papers. Processor will accept any size sheet of film or paper from 6 by 8 inches to 20 by 25 inches. The exposed film or negative material is fed into one end of the processor and travels via belt and roller feed in a predetermined time sequence through developing, fixing, and wash tank before emerging at the other end to be hung up to dry.

The process takes eight minutes and life of the negative is approximately ten years. A variable speed control permits overall processing time to be set at any point between 8 and 16 minutes. Unit holds 18 gallons of developer, and is replenished by gravity feed from a 3-quart bottle. A water jacket surrounding the developer tank provides accurate temperature control to ±½ degree. **Haloid Co.**, Rochester 3, N. Y.

Circle 428 on Page 17



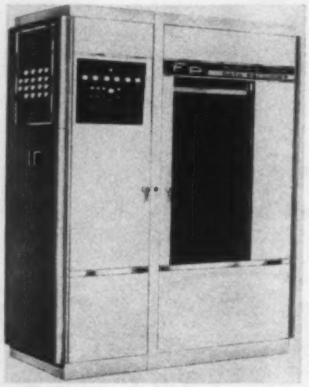
Package Sorter

Item 429

Unit used for automatic sorting of packages according to size, weight, or classification. The 3-way switch can dispatch packages into side aisles at the right and left, or straight through. It can be controlled by remote pushbuttons, limit switches, photoelectric cells, and other electrical means. Scale controls may divert underweight and overweight packages to the right and to the left, while those that measure correctly pass straight ahead.

Automatic diversion to a bypass line can be made if the main conveyor line blocks. The switch can also be used to feed tributary lines into a common main line with the switch bringing in a new line when cartons from one line have been cleared. Conveyor is available in four widths from 12 to 24 inches. Turns are either 45 or 90 degrees. **E. W. Buschman Co.**, Clifton & Spring Grove Aves., Cincinnati 32, Ohio.

Circle 429 on Page 17

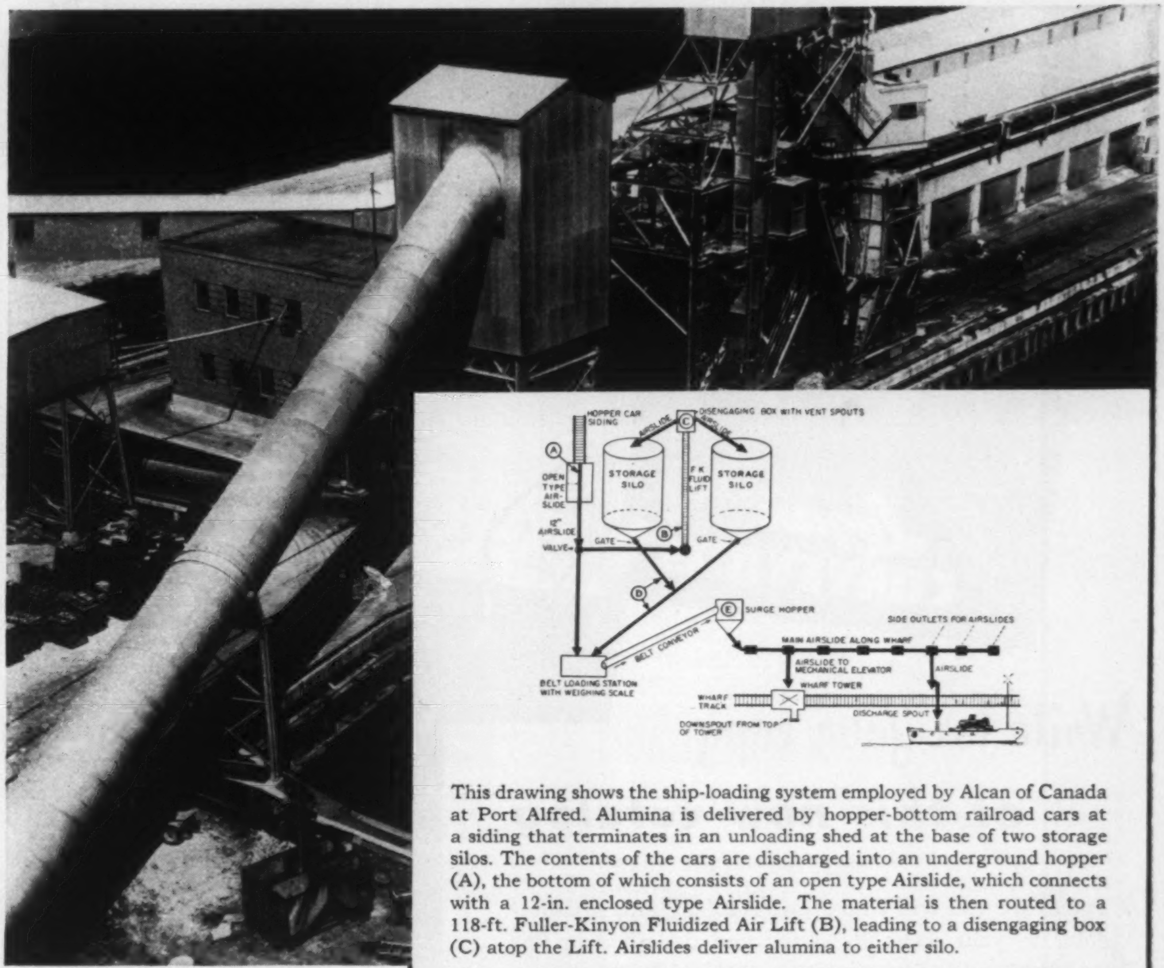


Industrial Data Logger

Item 430

Data logger and alarm scanner suitable for industrial use simultaneously records a variety of inputs up to a maximum of either 200 or 2000, depending on the scanning method selected. Inputs can be ac, dc, variable frequency, or pneumatic. Two scanning systems are available. One utilizes individual point relays, with individual alarm limit set points and ranging adjustments, to provide maximum reliability and flexibility. The other provides ten times the input capacity by means of ten-point stepping switches. All points on a stepping switch share the same alarm limits and the same programs.

Programs and format are easily set up and modified to meet chang-


HOPPER CAR SIDING
DISENGAGING BOX WITH VENT SPOUTS
AIRSLIDE
AIRSLIDE
C
A
OPEN TYPE AIR-SLIDE
STORAGE SILO
F K FLUID LIFT
STORAGE SILO
12" AIRSLIDE
B
VALVE
GATE
GATE
D
E
SURGE HOPPER
SIDE OUTLETS FOR AIRSLIDES
MAIN AIRSLIDE ALONG WHARF
BELT CONVEYOR
AIRSLIDE TO MECHANICAL ELEVATOR
AIRSLIDE
BELT LOADING STATION WITH WEIGHING SCALE
WHARF TOWER
WHARF TRACK
DISCHARGE SPOUT
DOWNSPOUT FROM TOP OF TOWER

This drawing shows the ship-loading system employed by Alcan of Canada at Port Alfred. Alumina is delivered by hopper-bottom railroad cars at a siding that terminates in an unloading shed at the base of two storage silos. The contents of the cars are discharged into an underground hopper (A), the bottom of which consists of an open type Airslide, which connects with a 12-in. enclosed type Airslide. The material is then routed to a 118-ft. Fuller-Kinyon Fluidized Air Lift (B), leading to a disengaging box (C) atop the Lift. Airslides deliver alumina to either silo.

When a ship is readied for loading, alumina is drawn from the silos by open type Airslides and transported by means of 16-inch Airslides (D) to a belt, which delivers to a surge hopper (E) feeding the 400-ft. long Airslide for conveying to the ship. Air for the operation of the Fuller-Kinyon Fluid Lift is supplied by a Fuller Rotary Compressor.

Here's how ALCAN reduces ship loading time 50%

. . . FULLER SYSTEM PAID FOR ITSELF IN WEEKS

Expansion of The Aluminum Company of Canada's pneumatic conveying system at Port Alfred, Quebec, has cut ship loading time of alumina by 50 percent.

Engineered and built by Fuller, this pneumatic conveying system has eliminated frequent interruptions in the loading schedule and made possible big savings in handling cost. The initial cost of the installation was absorbed within the first few weeks of operation!

Additional equipment consists of two 35-ft. portable F-H Airslides® operating in tandem off of a main 19-in. Airslide running a distance of 400 feet along the roof of the wharf. These Airslides discharge the alumina directly into the hold of the ship, eliminating the time-consuming shutdown during relocation of the bucket elevator and tower for delivery to various holds.

This carefully planned system points out how Fuller's more than 30 years of specialized experience in engineering and manufacturing pneumatic materials-handling equipment helped another company save time and money. We would like to put our facilities to work for you, too. Write, giving us details of your operations.

FULLER COMPANY
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Fuller
. . . pioneers in harnessing AIR

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162 Bridge St., Catasauqua, Pa.
SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION
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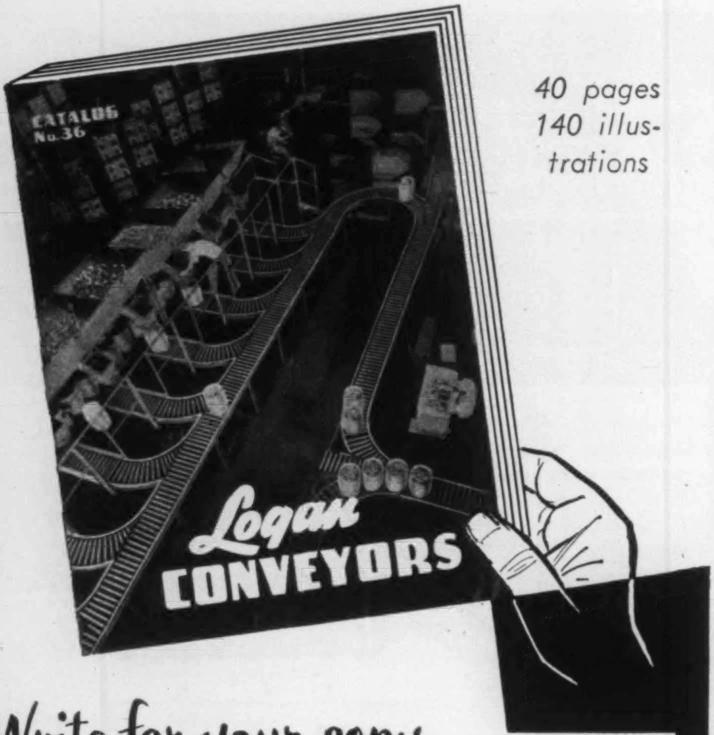
G-167
4365

Circle 688 on Page 17



40 pages
140 illustrations

Write for your copy

of this new catalog

Chances are you will find a material handling situation similar to your own, illustrated and described in this new book!

The 140 actual installation photos in the Logan catalog show where and how to use the principal types of conveyors to best advantage in meeting individual plant conditions. Both standard and special applications are shown, making this book a valuable and informative reference, whether or not you contemplate using additional conveyors at this time.

PLANT
OFFICE

Tell her to write for the new Logan book today

Write today. Perhaps you will discover here that handling solution you have been looking for. There is no obligation in requesting your copy.

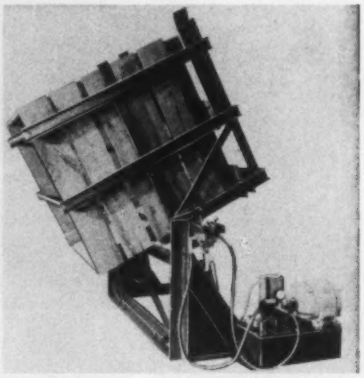
LOGAN CO., 218 CABEL ST.
Louisville 6, Ky.

Logan Conveyors

Circle 682 on Page 17

ing process requirements. Pin location establishes sequence in which inputs can be measured and read out, and permits readout of any input any number of times per logging cycle. It can select any input for visual readout on a digital in-line display. The pinboard permits control of all other scan-log functions for each reading by the insertion of pins which designate the type of measurement. Inputs are continuously scanned and compared against limit set points. Detection of an off-normal condition can result in a complete printing of all points, with alarmed points in red. "Building-block" construction of the logger allows for expansion of a system, and plug-in subassemblies and pinboard programming make for flexibility of operation. **Fischer & Porter Co.,** 292 Jacksonville Rd., Hatboro, Pa.

Circle 430 on Page 17



Pivot Dumper

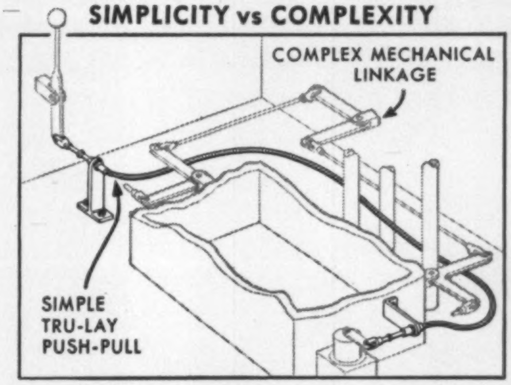
Item 431

Machine is designed for dumping heavy loads where no lifting is required. Dumping action is provided by two large hydraulic cylinders powered by a packaged motor-driven hydraulic power unit. A manually operated lever sets the unit into motion. When the lever is set forward, the dumper pivots 135 degrees and stops when the dumping angle reaches 45 degrees from vertical. When the lever is set back, the dumper automatically returns to the loading position. Dumper can handle skid boxes, pallet boxes, drums, barrels, and special in-plant containers with loads up to 4000 pounds. **Essex Conveyors Inc.,** P. O. Box 27, Nutley, N. J.

Circle 431 on Page 17

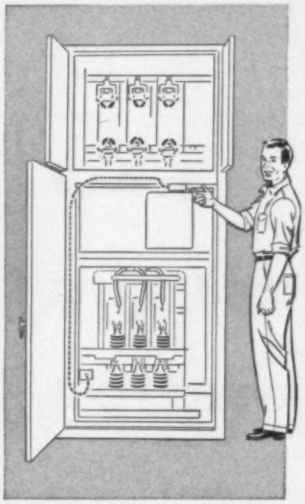
Design Engineers find PUSH-PULL Controls eliminate complicated mechanical linkages

SIMPLICITY vs COMPLEXITY



Compare the TRU-LAY PUSH-PULL cable in the illustration with the mechanical linkage. PUSH-PULLS are simple, have but one moving part, are noiseless and give lifetime service accuracy. Linkages are complex, made of many parts and wear at many points. Their use brings increasing backlash, lost accuracy and vibration.

USED AS A DOOR INTERLOCK IN HIGH-VOLTAGE CABINET



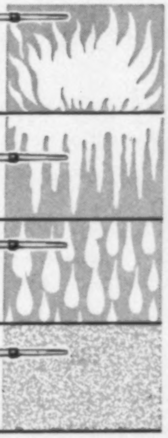
TRU-LAY PUSH-PULL cable insures high-voltage load is OFF before door can be opened.

Saves Space because it is flexible as a wire rope and fits easily into limited space.

Easy to Install with a simple clip where loads are light—clamped at the conduit fittings with a machined bracket.

Economical because it requires no maintenance. We have never known a TRU-LAY PUSH-PULL to wear out in normal use.

VERSATILE TO MEET THE TOUGH JOBS



HOT JOBS TRU-LAY PUSH-PULLS will function under high temperatures. Are ideal controls for jet aircraft and industrial furnaces.

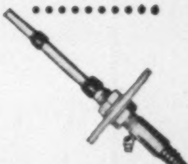
COLD JOBS TRU-LAY PUSH-PULLS will function accurately in cold as low as —70°F.

WET JOBS TRU-LAY PUSH-PULLS are highly water-resistant by virtue of their construction.

ABRASIVE JOBS TRU-LAY PUSH-PULL cables can be completely rubber-covered for extra protection.

TRU-LAY PUSH-PULLS will handle heavy, tough jobs with up to 1000 lbs. input. They are effective controls for remote jobs 150 feet or more from the control point. They are frequently and successfully used in conjunction with electric, hydraulic and pneumatic controls.

CHECK THESE FEATURES AGAINST YOUR REQUIREMENTS



ADAPTABILITY • Approximately 80% of installations are met by standard anchorages, fittings and heads. Simple modifications meet almost every design requirement.

ACCURACY • TRU-LAY PUSH-PULLS are precision-built products. Accuracy is inherent in the basic design and standards of quality.

TROUBLE-FREE • TRU-LAY PUSH-PULLS are sealed against the entrance of dust, dirt or other foreign matter. The inner working member is lubricated for life.

LONG LIFE • Every feature of TRU-LAY PUSH-PULL construction makes these controls strong, highly resistant to stretch and compression, yet extremely flexible. None has ever worn out in normal service.

Push-Pull
DATA FILE

The six bulletins and booklets in the **DATA FILE** *will answer many questions on PUSH-PULLS. Write for your copy.*

ACCO

AUTOMOTIVE and AIRCRAFT DIVISION

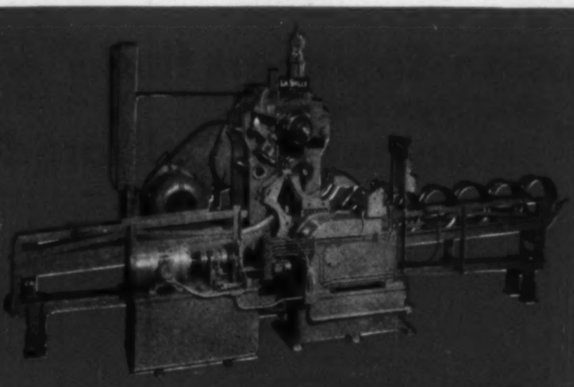
AMERICAN CHAIN & CABLE

601 Stephenson Bldg., Detroit 2
2216 South Garfield Ave., Los Angeles 22 • 929 Connecticut Ave., Bridgeport 2, Conn.

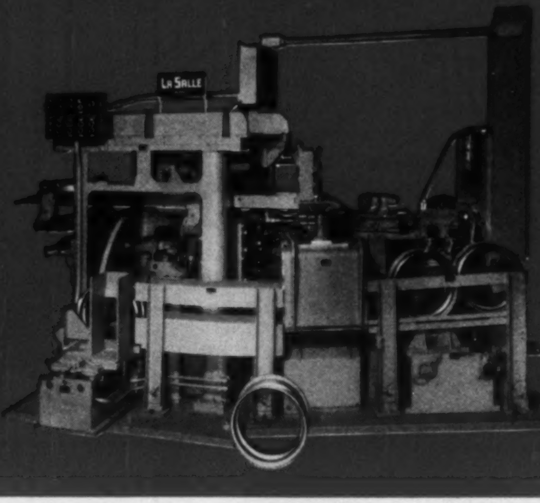
TRADE MARK

La Salle

Wheel Rim-amatic



new wheel rim automation line



Engineered to give you machine tool precision, High Speed production and complete automation

3 Interlocked Forming Machines

It's a series of three forming machines, with automatic load and unload mechanisms, electrically interlocked to form a continuous line. It's designed and built for the volume production of precision formed wheel rims.

Self-Contained

The Self-contained units are completely wired, with many built-in features, and are ready for immediate use. You merely connect the power lines, once the machine has been set in position—and it operates automatically.

LaSalle Shuttle Transfer

An automatic (LaSalle) shuttle transfer mechanism moves the wheel rims to the load position on the final sizing press, from a vertical plane in the third forming machine, to a horizontal plane in the final sizing press.

Automatic Features

The wheel rims progress through this new precision machine—through the 3 interlocked forming units—as a continuous automatic operation. EVERY OPERATION IS COMPLETELY AUTOMATIC! Here's a simplified version of what takes place along the way in this new "LaSalle Wheel Rim-amatic"—after proper channelling; proper cycling; proper indexing; and, precision forming, the finished wheel rims are fed from the final sizing press—automatically.

Production Plus

This new LaSalle wheel rim automation line, already in operation in a manufacturing division, of one of the Big 3, where precision and high production is a must, has proven to be a real production asset.

Requests for information honored promptly.

La Salle tool, inc.

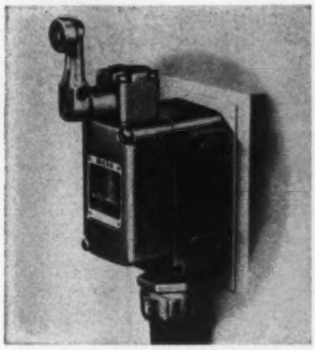
ENGINEERING & BUILDING
SPECIAL MACHINERY

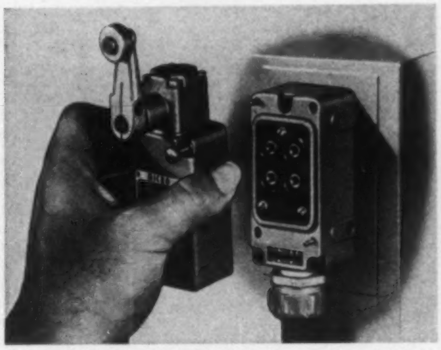
3840 EAST OUTER DRIVE • DETROIT 34, MICHIGAN

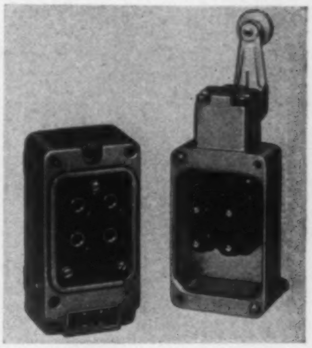
AUTOMATION new components

Parts, elements and devices designed for creating more automatic systems

For detailed information and literature, use card page 17.







Plug-In Limit Switch Speeds Maintenance Replacement

Designed to reduce downtime in maintenance on automatic production lines, moving parts of switch can be replaced in 20 seconds, have accurate positioning, and need no adjustments. Replacement of the switching element requires only a screwdriver and takes four steps: loosening two screws, pulling off the switch, plugging in the replacement, and tightening the screws. Steps required in replacing a conventional switch include disconnecting the conduit, removing cover screws and plate, disconnecting wires, removing screws and switch, replacing screws and mounting new switch, rewiring switch, connecting and sealing conduit, replacing cover and screws, and adjusting actuator. Equipment needed for conventional switch replacement includes a screwdriver, wrench, sealing washers, and possibly a soldering iron.

The most time consumed to replace a conventional switch is associated with the functions of those parts which are permanent, nonmoving parts and not subject to damage or wear. These functions are mounting, connecting, and sealing the conduit and wiring the switch terminals. Design of the new limit switch eliminates most of the time and equipment previously needed. One half of the new switch was designed to be permanently sealed and mounted in place and is called the terminal block enclosure. The other half of the switch, the switch enclosure, contains all the moving mechanical and electrical parts of the switch. The switch enclosure is fitted with four current-carrying spring plugs, integrally molded to the basic switching element. Molded barriers protect the plugs from damage and provide long over-surface dielectric spacings.

The terminal block enclosure is permanently mounted on the machine. The phenolic terminal block including the receptacles for the four spring plugs can be wired and mounted in place inside the enclosure. Heavy terminal screws and special clamps allow use of stripped wire ends or standard lug connectors. Lock washers insure trouble-free connections. The recessed design around each receptacle prevents inadvertent grounding, while continuity tests can be accomplished using ordinary test prods. Under normal conditions the terminal block and enclosure need not be removed from the machine. The switch enclosure is plugged into the terminal block, precisely positioned by means of dowel pins, and held by two screws.

A ring type seal around the opening of the terminal block enclosure seals the junction of the two parts. Seals around the actuating shaft and between the operating head and switch body make the unit oil and dust tight. Adjustable positions are available to suit various operating requirements. Electrical actuation can be obtained in both directions, or in one direction only, either clockwise or counterclockwise, while still providing full overtravel in the opposite direction. The operating head can be faced in any of four directions. Aluminum roller arm can be positively locked at any position through 360 degrees and can be reversed to permit inboard roller location. The terminal block enclosure can be mounted on three surfaces and from four directions. Switch is rated 10 amp, 120, 240, or 480v ac; ½ hp, 120v ac; 1 hp, 240v ac; 0.8 amp, 115v dc; 0.4 amp, 230v dc; 0.1 amp, 550v dc. **Micro Switch, div. of Minneapolis-Honeywell Regulator Co.,** Freeport, Ill.

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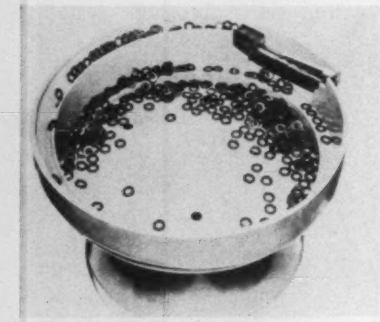

Lock Washer Feeder

Item 433

Unit is designed so lock washers of the noninterlocking spring type can be oriented through an escapement track direct to a desired application. Track travel of 40 ipm provides a feeding rate of 15,000 parts per hour. Lock washer sizes from ⅛ to ⅞ inch have been fed, and larger sizes can be processed by increasing the size of the bowl and drive unit. The lock washer split can be positioned on the top (shown), on the side, or trailing. The connector track can be designed for vertical or horizontal delivery to the point of application. **Perry Equipment & Engineering Co., div. of Automation Devices Inc.,** 3125 Brandes St., Erie, Pa.

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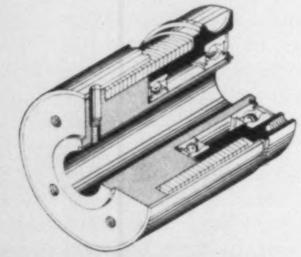

Over-Running Clutch

Item 434

Suitable for all over-running, indexing, and backstopping applications, clutch is based on a coil spring around driving and driven drums. The inside diameter of the spring is smaller than the diameter of drums; thus the spring is in interference fit with the drums, producing diametral squeeze which causes the spring to grip both drums. In the driving direction the spring coils more tightly and increases its grip on the driving and driven drums, transmitting the torque. Torque in the opposite direction tends to uncoil the spring and expand it. As the spring expands, the radial force or squeeze is decreased, allowing the clutch to over-run. When the clutch takes hold, there is little movement of the spring on the surfaces it is gripping, and the spring and both units revolve as a solid unit. The clutch is self-energizing, and does not require an externally operated means of actuation. Ball bearing units are available from 20 to 3000 lb-ft torque capacity; sleeve or plain bearing units from 8 to 200 lb-in. capacity. **Marquette Div., Curtiss-Wright Corp.,** 1145 Galewood Drive, Cleveland 10, Ohio.

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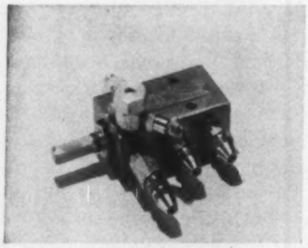

Lubricating Pump

Item 435

Unit provides automatic centralized lubrication suitable for hydraulically operated equipment such as shapers, surface grinders, planers, broaches, milling, and boring machines. Pump connects to an existing supply line of the hydraulic system and gives positive lubrication as the machine operates. No special valves or drives are needed. The unit is designed to operate where a machine cylinder is hydraulically powered in either one or two directions. Pump is available in 3 sizes and can operate in conjunction with lubricant reservoir assemblies of 1½, 3, 5, 8, and 12 pound or pint capacities. **Trabon Engineering Corp.,** 28815 Aurora Rd., Solon, Ohio.

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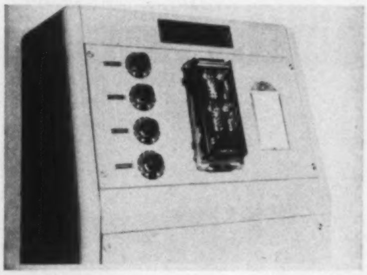

Formula Board

Item 436

Unit is adaptable in the program control of batching operations; is used for pre-setting weight data in an automatic proportioning panel. When used with company's Select-O-Weigh system, it provides automatic control over storing, feeding, conveying, weighing, mixing, and discharging of bulk ingredients. Operations are faster and more accurate, especially for processors using many mixing formulas with frequent changeovers. Changeover is accomplished by removing one formula board and replacing it with another of predetermined settings. In operation, the operator inserts the formula board into position and presses a *Starter* button, and the proportioning and mixing operations are continued automatically, without interruption. **Richardson Scale Co.,** Clifton, N. J.

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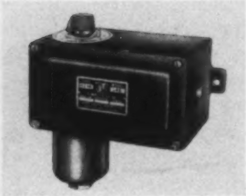
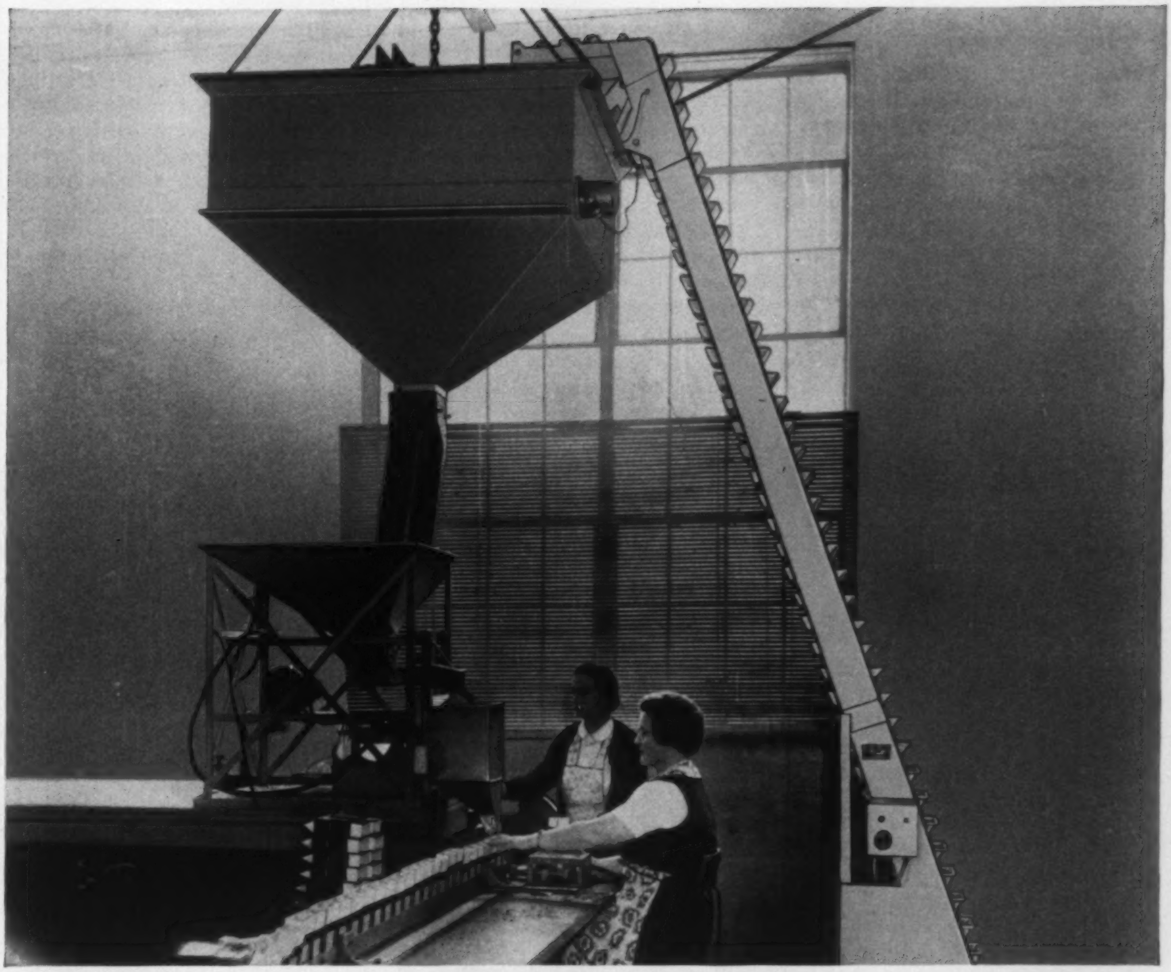


Pressure Switch

Item 437

Unit provides two completely separate switch actions, permitting control of two independent circuits, and flexibility of switch arrangement. Model H27A has a calibrated dial and single turn ad-



ROBO-LIFT MOVES MATERIALS UP-AND-OVER AT LESS COST!

Wherever bulk materials must travel up from one processing step and over to the next, it will pay you to consider the Lynch Robo-Lift. It saves time, manpower, and money because it does the entire job *automatically*, with no costly rehandling. Robo-Lift's clean, gentle, filling-without-scooping action handles food, drugs, chemicals, hardware (and just about everything!). It can't crush or contaminate materials, will not spill them, will not leak. Each installation is custom-designed to work with existing processing and packaging equipment. New folder "Up and Over" gives full facts. Write for it today.

ROBO-LIFT BUCKET ELEVATING CONVEYORS

LYNCH ROBO
CORPORATION

A division of
LYNCH CORPORATION
Anderson, Indiana

justment knob and pointer for making pressure settings. Individual switch adjustments are made by independent hex head screws located inside the enclosure. The span between settings is maintained throughout the range. Line of eight models is offered in adjustable ranges between zero and 180 psi limits, and maximum pressures up to 180 psi. **United Electric Controls Co.,** 79 School St., Watertown 72, Mass.

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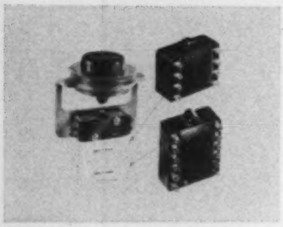

Pushbutton Actuator

Item 438

Unit is applicable to commercial electronic equipment, appliances, vending machines, and other uses. Model A4-67 is designed to fit three of company's basic switches, permitting a wide range of circuit arrangements. The actuator button is housed in an independent threaded bushing unit which screws into the bracket to act as an adjustment for panel thickness variations and also as a lock nut for panel mounting. Actuator can be mounted to panels from 1/16 to ⅛ inch thick. The knurled ring nut permits fast, hand installation. **Electro Snap Switch & Mfg. Co.,** 4218 W. Lake St., Chicago 24, Ill.

Circle 438 on Page 17

+7895
DIGITAL VOLTMETER

Digital Voltmeter

Item 439

Instrument is applicable in telemetering and test system calibration; computer input, output, and reference supply measurements; strain gage, thermocouple and other transducer output measurements; production testing of electronic instruments; chemical or other industrial process control; and calibration of all types of laboratory and industrial electronic instruments. Model 401 DC has a single plane, wide angle readout with non-overlapping characters.

Features of the unit include automatic, continuous calibration against an internal standard cell, 100 microvolt dc sensitivity, 10 megohm input impedance, and a range from 0.0001 to 999.9 volts with automatic polarity indication and automatic decimal placement. Accessories available are converters for measuring ac, ohms, ratios; scanners for sampling data from multiple inputs; and serial converters to permit driving typewriter and punched tape units. **Kin Tel,** 5725 Kearny Villa Rd., San Diego 12, Calif.

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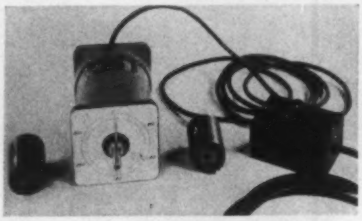


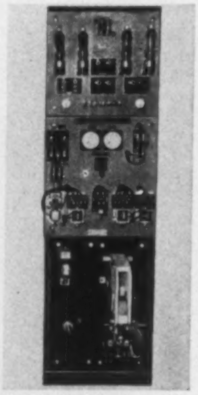
Step Motor & Control

Item 440

Device is applicable with tape control mechanisms for operating machine tools, for incremental indexing of computers and digital systems, and for other types of machinery requiring accurate remote power positioning. The step motor indexes in 60-degree, 30-degree, 15-degree or smaller steps. The step motor is based on the principle that when a squirrel cage rotor having a special grouping of bars is placed in a single phase field, the rotor will position itself in a definite relation to this magnetic field.

Rotor indexing is obtained by energizing the stator windings in the desired sequence. Three control wires provide six or more steps per revolution; continuous connections to the leads provide continuous stepping. The motor can be operated at slow speed and, without declutching, driven at high speeds. It can stop and hold at a fixed point in a revolution, and two or more units can be accurately synchronized. **B. A. Wesche Electric Co.,** 9027 Shell Rd., Cincinnati 42, Ohio.

Circle 440 on Page 17

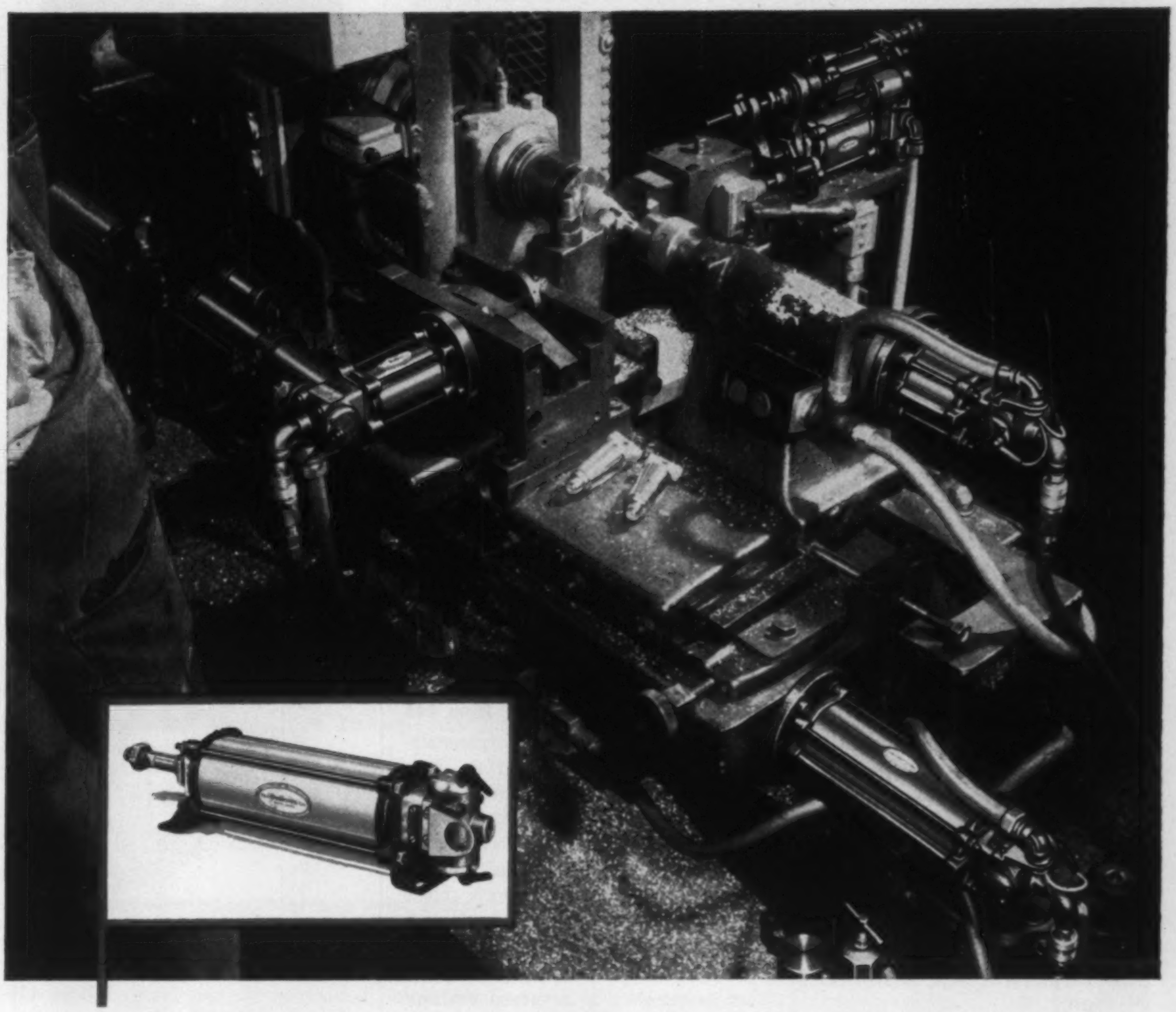


Mill Regulator

Item 441

Unit is applicable in the paper, rubber, glass, and non-ferrous metals industries. Model VSMR, a dual circuit, variable speed electronic mill regulator, operates on two sets of output thyratron tubes operating in parallel. Each set of tubes is capable of handling the output load without exceeding the tube rating. In normal operation, the tubes share the load. When there is tube failure in one half of the regulator, the two tubes in the operable half automatically carry the entire load.

The output section can operate into the motor field or the generator field of any drive to accurately control speed, tension, and voltage within the rated limit of a single pair of tubes. The thyratron tubes give a bluish glow when in a serviceable condition, allowing a visual check of tube operation. Tubes can be replaced while the drive and regulator are in operation by removing the anode cap and installing a new tube. Special purpose electronic circuits imbedded in solid blocks of resilient plastic resin are used throughout the regulator. These electronic building blocks are impenetrable to moisture, acids, grease, dirt, vibra-



THE BELLOWS AIR MOTOR WITH ITS BUILT-IN ELECTRIC VALVE OFFERS NEW WAYS TO TRIM COSTS IN MANY VARIED OPERATIONS

In every industry you will find this unique air cylinder sparking cost reduction ideas and delivering that cost reduction in hundreds of different ways . . . from packing gardenias to drilling holes; from sorting conveyor traffic to lifting hospital beds; from feeding turrets to spinning rivets. The Bellows Air Motor puts "practical" automation within the reach of every plant.

Here's a typical example:

Hays Mfg. Co., Erie, Pa.: Chief Engineer Henry Schneider working with Frank Moore, Bellows Field Engineer, designed conversion (shown above) of a mechanically driven standard machine for turning tapered brass valve plugs, to a completely automatic air-powered operation. The application of the Bellows units was made in Hays' toolroom. Now, two men at two converted machines turn out more production than was previously obtained from four machines and four operators. Also, the quality of the finish on the plugs produced on the Bellows equipped machines eliminates 50% of the lapping time required by the old machining method.

What can it do for you? It can provide an inexpensive, easily controlled power source to perform almost any push, pull, lift or turn motion. It can make such standard machines as drill presses, lathes, millers, grinders fully automatic. It can be the heart of shop built, low cost, special purpose machines. *It can give you a fresh, new approach to the problem of cutting costs.*

Your Bellows Field Engineer (listed in the phone book under The Bellows Co.) will be glad to discuss possible applications with you. Or write The Bellows Co., Dept. AU 158, Akron 3, Ohio, for copies of Bulletins ML-3 and BM-25. In Canada, address Bellows Pneumatic Devices of Canada, Ltd., Toronto 18.

The Bellows Co.

DIVISION INTERNATIONAL BASIC ECONOMY CORPORATION

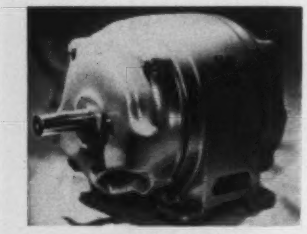
AKRON 9, OHIO

9798

Circle 693 on Page 17

tion and other conditions common to industrial machinery applications. **Reliance Electric & Engineering Co.,** 24701 Euclid Ave., Cleveland 17, Ohio.

Circle 441 on Page 17

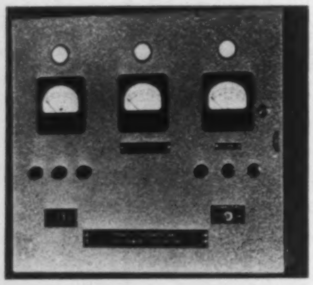


Enclosed Motors

Item 442

Features of units include increased horsepower, drip-proof design for protection against environmental hazards, a 2-way ventilation system for uniform cooling of the motor, asbestos insulation for better protection to windings, and a dynamically balanced, solid cast rotor for smoother operation. All ball bearings are lubricated by a system in which grease is injected transversely through the bearing, completely replacing old grease with new. Compact construction of the motor provides savings in space. **U. S. Electrical Motors Inc.,** Box 2058 Terminal Annex, Los Angeles 54, Calif.

Circle 442 on Page 17

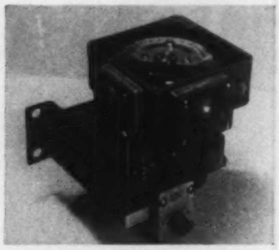


Ground Detector & Alarm

Item 443

Model PRD is an electrical device with visual and audible alarms that indicate drop in line to ground voltage for any phase of a 3-phase system. Detector sensitivity adjustments are made at the installation with normal operating load by moving the rheostat pointer knobs on the drop-out and pick-up rheostats to the voltage differential desired. When voltage to ground on any phase drops under preset voltage on drop-out rheostat, voltage through relay drops causing relay to drop-out opening circuit to master relay, causing master relay to drop-out, closing transformer circuit to alarm and light. **Principle Research & Development Co.,** Box 93, Franklin Park, Ill.

Circle 443 on Page 17



Pneumatic Controller

Item 444

Device is suitable for transmitters with 3 to 15 psi output. Proportional band is adjustable from 2 to 500 per cent; reset rate is adjustable from 0.1 to 50 repeats per minute. The proportional band is changed by loosening a lock screw and moving it along a scale. A calibrated needle valve allows repeating a reset rate, and controller action can be reversed without changing parts.

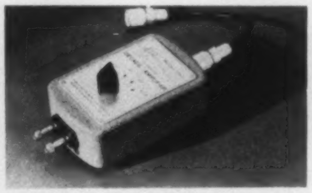
Operating principle of the controller is the null-balance principle which permits compactness, versatility and interchangeability of components without sacrificing accuracy or sensitivity. Instrument is available for either panel or post mounting, and can be furnished with a weatherproof cover. **Republic Flow Meters Co., Subsidiary of Rockwell Mfg. Co.,** 2240 Diversey Parkway, Chicago 47, Ill.

Circle 444 on Page 17

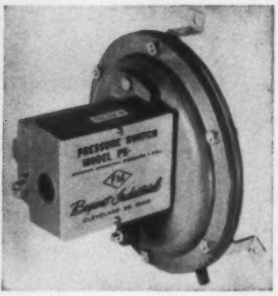
Transistor Amplifier

Item 445

Unit is designed to magnify weak input signals and to extend the sensitivity of high impedance input devices such as oscilloscopes, oscillograph amplifiers, null balance recorders, and vacuum tube voltmeters. Model 194G is suitable for use with ac strain gage bridge circuits, has a low noise level, is hum free and nonmicrophonic. Gain of 1, 10, or 100 is obtained by setting a selector switch. It operates from two self-contained 5v mercury batteries. Batteries have a life of approximately 1000 hours of continuous operation at normal room temperature. **Taber Instrument Corp.,** Section 78, N. Tonawanda, N. Y.



Circle 445 on Page 17



Pressure Switch

Item 446

Unit is adaptable to control and safety functions, and can be used to prove the presence or absence of pressure, vacuum or flow of air and inert or combustible gases. Applications include use in automated process control; checking vacuum or pressure in manufacture of electronic tubes and electrical lamps; supervision of pressurized or ventilated refinery control houses; continuous checking of air filters, and control of gas combustion systems.

Pneumatic pressure switch is capable of closing a 1200w circuit under preselected pressure, suction, or the differential sum of two pressures over a range of from 0.1 inch water column to 1 psi. Pressure chambers enclose a high stability diaphragm which acts against adjustable spring pressure to trip a sensitively mounted mercury switch. Three interchangeable color-coded springs adapt the

CUT COSTS

with the Original Mead

MIDGET AIR CLAMP

(Spring Return Air Cylinder)

Only
$3.95
EITHER STYLE
($40.80 Per Dozen)

In assembly jigs and other multiple applications, this new, low cost pressure unit saves countless man-hours. As a work-ejector in many fixtures, it is unexcelled.

Advantages over mechanical clamps

1 All Air Clamps in any set-up can be operated by a single master valve—the "lock-up" and release of assemblies is instantaneous.

2 May be installed in cramped corners difficult to reach with bulky mechanical clamps. Mead Midget is the most compact air cylinder, for its power, on the market.

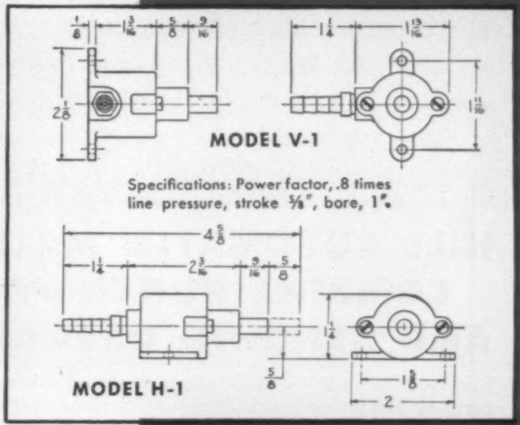
3 Equal ram pressure at any point along stroke, making special, delicate adjustments unnecessary.

4 Independent group control. Any desired group of "Midgets" can be controlled independently of any other group in an assembly—as where primary members of the fixture must be locked up before the secondary members.

5 Facilitates delicate drill operations. Air Clamps actuated by foot control valves leave operator's hands free to handle the work pieces.

Send for all the interesting facts on these time-tested, superior Midget Air Clamps.

MEAD SPECIALTIES COMPANY
4114 North Knox Avenue • Dept. A-18 • Chicago 41, Illinois


1/8
1 3/16
5/8
9/16
2 1/8
MODEL V-1
1 1/4
1 13/16
1 11/16
4 5/8
1 1/4
2 3/16
9/16
5/8
1 1/4
5/8
1 5/8
2
MODEL H-1

Specifications: Power factor, .8 times line pressure, stroke 5/8", bore, 1".

IMMEDIATE DELIVERY

Single-acting cylinders delivered from stock; double-acting in a few days.

Tear Out MEMO Coupon Now For

New MEAD INDUSTRIAL AIR POWER CATALOG

Full of suggestions for faster, cheaper production with famous **MEAD AIR-POWERED** Cylinders, Valves, Presses, Vises, Chucks, Hammers, Drill Press Feeds, Work Feeders, semi-automatic combinations, etc. Send today.

MEAD
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MIDGET AIR CLAMPS
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4114 N. Knox Ave., DEPT. A-18, Chicago 41, Illinois

Send free copy of new, colored MEAD INDUSTRIAL AIR POWER CATALOG describing the complete line of famous Mead air-operated devices.

Name__________________________________

Company________________________________

Address________________________________

City________________Zone____State______

Circle 694 on Page 17

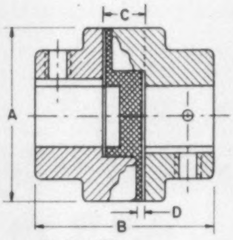
switch to three pressure ranges. A screwdriver adjustment sets the desired trip pressure anywhere within the range of the installed spring.

Each chamber is tapped for pressure, vent, or suction connections, the large chambers absorbing pulsation. An inspection window in the switch case allows a ready check of mercury switch functioning and the color code of the particular spring in use. The whole switch assembly panel can be removed without disturbing pressure connections, as there is no direct mechanical connection between the spring plunger and the diaphragm. **Bryant Industrial Products Corp.,** 17700 Miles Ave., Cleveland 28, Ohio.

Circle 446 on Page 17

Flexible Coupling

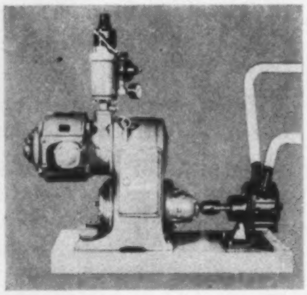
Item 447



Side View, L-075

Unit can be equipped for various operating conditions such as exposure to oils, chemicals, water, steam, and abrasion, depending on the choice of cushioning materials. Coupling transmits loads through a one-piece spider type load cushion, eliminating wear and abrasion on the metal jaws. Since only the load ends are under compression on non-reversing loads, the entire spider can be reversed for double service life. Model L-075 is rated for loads of 1/10 hp at 100 rpm up to 2 hp at 3600 rpm. Bore sizes range from ¼ to ⅞ inch. Dimensions are 1¾ inch largest diameter by 2⅛ inch over-all length. **Lovejoy Flexible Coupling Co.,** 4984 W. Lake St., Chicago 44, Ill.

Circle 447 on Page 17

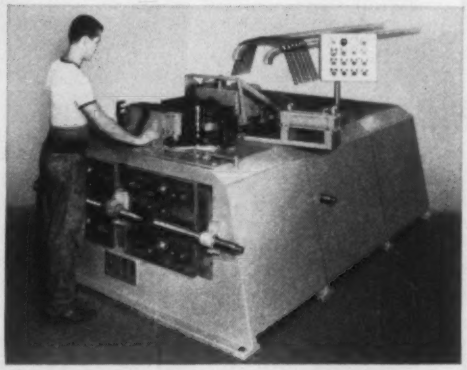


Pump-Motor Set

Item 448

Unit is suitable for use in controlling and varying rates of flow of corrosive fluids and abrasive slurries. A linear relationship between speed and output can be obtained with the pump driven by a variable speed source. The variable speed can be obtained by using an integral variable speed motor drive in which provision is made for automatic process control by using an air cylinder to set the rpm of the variable speed drive. An air signal, operating at an instrument pressure of 3-15 psi, is the sensing and controlling portion of the system. The signal pressure controls the power air through an amplifier, controlling the rpm

WALTER P. HILL



Tubular chair legs are produced at a rate of 1,440 pieces per hr on this Hill machine. Production savings in less than six months justified the machine purchase price.

HILL AUTOMATED MACHINES COMBINE PUNCH PRESS AND BENDING OPERATIONS

Now you can achieve significant production savings on tubular parts by combining punch press and bending operations on Hill fully-automated machines. Piercing, countersinking and flattening operations, as well as coining of weld projections can be combined with multiple bending in a single, versatile, high-speed machine.

These new horizontal punch press and multiple bending combination machines utilize unique press bending principles and hydraulic power systems to produce up to two and more parts at a time. They are ideally adapted to the production of tubular furniture, automotive and aircraft molding and trim, and will also handle angle, square or rectangular-section shapes.

If you produce 50 or 50,000 pieces a day, it will pay you to investigate Hill advanced designs. Send part specifications and production requirements for prompt quotations on cost-saving equipment.

Write for this catalog giving complete information on Hill specialized hydraulic bending machines, double-end machines and extrusion equipment.

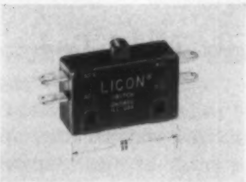
WALTER P. HILL, INC.
22183 Telegraph Road • Detroit 19, Michigan

Circle 695 on Page 17

of the pump drive.

For constant liquid level control the lowering of a float signals a speed increase to the variable speed motor driving the pump; as the level increases, the pump speed is automatically reduced. The pump has no stuffing boxes or shaft seals and the fluid conveyed contacts only the materials used in a unique liner and the body block. Pumps are self priming and flow rates from fractional to 40 gpm are available. **Vanton Pump & Equipment Corp.,** 201 Sweetland Ave., Hillside, N. J.

Circle 448 on Page 17

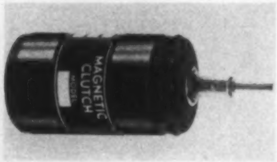


Subminiature Switch

Item 449

Stainless steel springs are a feature of subminiature switch, Model 16. Unit measures 25/32 by 7/16 by ¼ inch, exceeds 10 million cycles, and has 10 amps, 30v dc inductive or 115v ac. Double break contacts with four terminals increase electrical life and offer more circuit connection possibilities. Double-end plunger bearing allows the switch to operate directly from cams. High overtravel and positive stop helps make the operation possible without actuators. **Licon Switch Div., Illinois Tool Works,** 2501 N. Keeler Ave., Chicago 39, Ill.

Circle 449 on Page 17



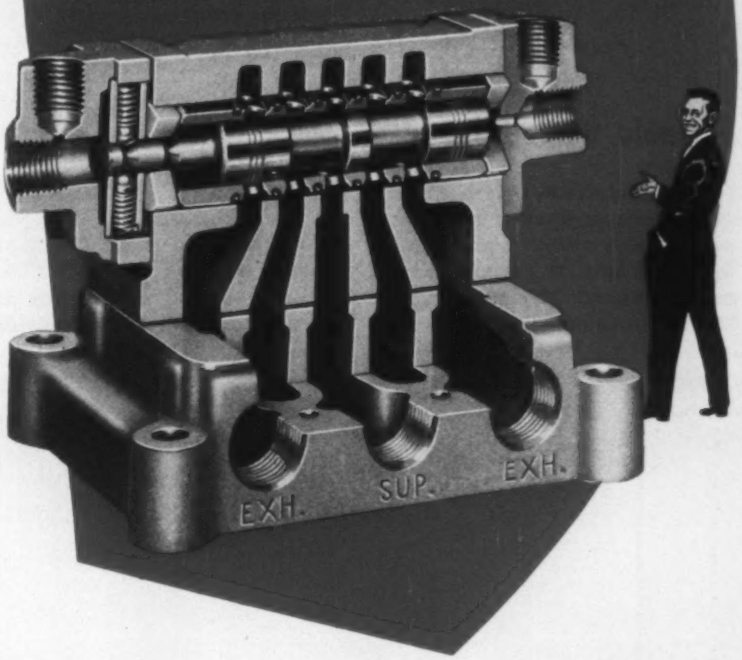
Friction Clutch/Brake

Item 450

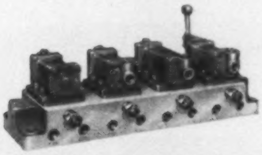
Device is applicable to low power servomechanisms. Model D104 operates on 24v dc, can be wound for 1.5 to 300v. Unit delivers a minimum of 8 oz-in. of clutching

Specify NUMATICS VALVES
... there are no "equivalents"

VERSATILITY...
UNMATCHED IN PILOT OPERATED VALVES



Numatics leads the way again, with a brand new line of pilot operated, 4-way valves, using Numatics' famed lapped spool floating sleeve action . . . action that permits applications ordinary valves can't handle. For example, these valves take vacuum and pressures to 300 psi., with a pilot pressure, independent of main line pressure . . . minimum pilot pressure, in fact, is 10-15 psi. even at 300 psi. main line! Further, Numatics' new line offers nine different valving actions, four pipe sizes and mounting styles in *144 models* . . . every one a multi-purpose valve that can be used eight different ways! Want the whole story? Write today . . . or better, call your local Numatics engineer.



NUMATICS MANIFOLDS
For mounting Numatics pilot operated or solenoid valves . . . interchangeably, if desired. Offered in 4 pipe sizes, 2 to 6 valve stations.

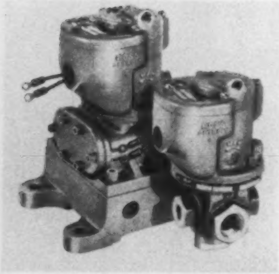
NUMATICS, Inc.
HIGHLAND, MICHIGAN Dept. A

MINIATURE PILOT VALVES
Now, too, a complete new line of miniature pilot valves is available for application with Numatics pilot operated valves, Numatics manifolds.

Circle 696 on Page 17

torque and braking torque; has a response time as low as 3 milliseconds; has power consumption of 3w. Angular displacement error upon engagement is held to a minimum. **Dynamic Instrument Corp.,** 59 New York Ave., Westbury L.I., N. Y.

Circle 450 on Page 17



Solenoid Valve Pilot

Item 451

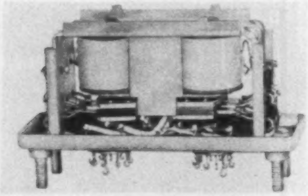
Pilot head can be mounted interchangeably on seven of company's valve bodies. Unit was designed to comply with JIC standards and has a life of 25,000,000 cycles. Valves bodies with which units can be used include straight-way normally open and normally closed and three-way open and closed in the in-line series; and three-way normally open and normally closed and four-way in the base-mounted series. **Ross Operating Valve Co.,** 120 E. Golden Gate Ave., Detroit 3, Mich.

Circle 451 on Page 17

Latching Relay

Item 452

Unit is designed to withstand high shock and vibration while operating on minimal power. Model KG uses a permanent magnet to hold the armature securely in any of the contact positions. Contact load capabilities range from dry circuits to 5 amp, 28v dc resistive, and to 3 amps, 115v ac resistive. The dual coil relay can remain operative during 100 g shock, with the contacts opening for no more than 80 microseconds. It can also withstand vibrations of 30 g acceleration from 55 to 2000 cps, and excursions of 0.195 inch from 10 to 55 cps with no contact opening. Relay needs only 2w at nominal voltage for 12 milliseconds to effect armature transfer. **Potter & Brumfield Inc.,** Princeton, Ind.



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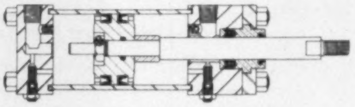
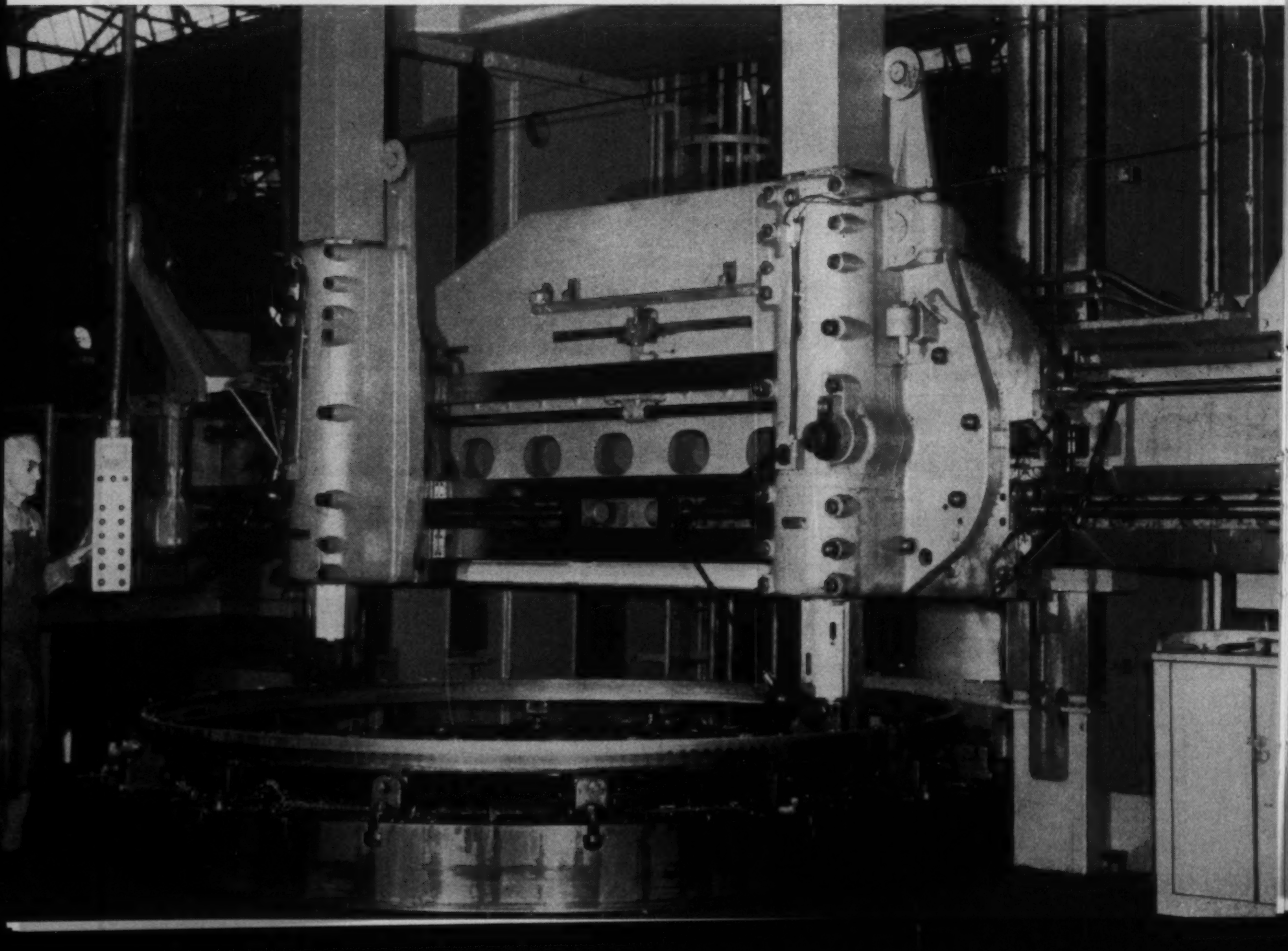


Square Air Cylinder

Item 453

Unit includes U-cup piston packing, chevron rod packing, and rod scraper made of homogeneous synthetic rubber. The piston is locked on the rod with nut and setscrew. After assembly, the cushion bushing, plunger, and piston are finish machined to assure concentricity.



Shell is honed to 15-20 microinches. Operating pressure of the cylinder is 200 psi, air or oil. Units are available in 1½ through 10-inch bore sizes. **Lynair Inc.**, 3100 Michigan Ave., Jackson, Mich.

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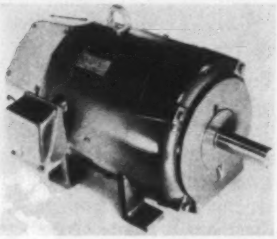


DC Motors & Generators

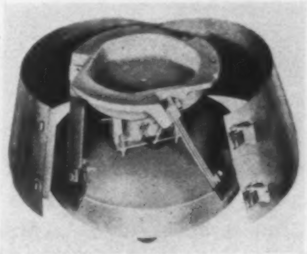
Item 454

Line of industrial dc motors and generators is designed to be effective as basic prime movers, or as elements of complex automatic production systems. Features of the motor and generator are a high-temperature silicone insulation system; a controlled ventilation system, and a housing construction which enables the dripproof machines to serve many applications which require splashproof equipment. A decrease in armature inertia and improved commutating ability give the motors fast dynamic response.

The insulation is equal to many emergency overloads and abnormal ambients, and the risk of burnouts is reduced. In the ventilation system, a fan at the shaft end is coupled with an air shield and a diffuser to impell air flow through the machine and out at the commutator end. Commutator dust is expelled rather than deposited upon the windings; and small particles in the incoming air stream are prevented from striking the commutator directly. Optimum cooling is possible with the diffuser which divides the air stream for most effective flow through the armature, air gap, and fields.

In the new housing, all commutator access openings have gasketed covers. The single ventilation opening in each bracket faces downward and has a rectangular flange suitable for simple connections to ducting. Brackets can be rotated to locate the vents properly for floor, wall, or ceiling mounting. The conduit box can be rotated for top, bottom, or side entrance, and can be mounted on either side of the frame. **Westinghouse Electric Corp.**, P. O. Box 2278, Pittsburgh 30, Pa.

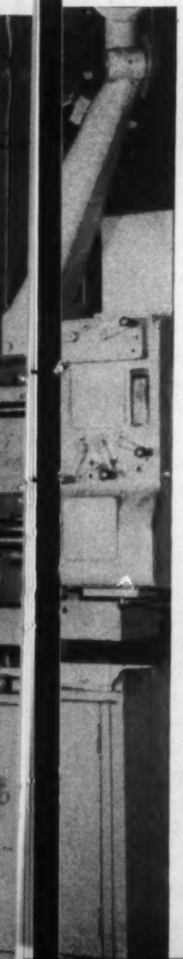
Circle 454 on Page 17



Vibratory Unit

Item 455

Designed to handle 24 inch bowls, vibratory unit incorporates a three spring suspension principle. The springs are arranged in a near vertical position for better balance and increased steady flow. Model 20 measures 20 inches in diameter and 13¼ inches high,



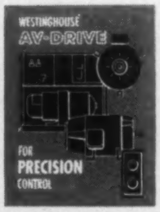
Westinghouse AV-DRIVE triples production on 14-inch boring mill

This mill at the Standard Steel Works Division of Baldwin-Lima-Hamilton Corporation, Burnham Plant, is doing the work formerly done by three belt-driven units, since it was equipped with a Westinghouse AV-Drive.

In addition to precision and adjustable speed necessary for turning, facing and boring, Westinghouse AV-Drives give Baldwin-Lima-Hamilton the versatility needed for profitable use of their huge metalworking facilities.

Do you have an adjustable speed drive problem? Ask your nearby Westinghouse representative about the AV-Drive. Or, write Westinghouse Electric Corporation, 3 Gateway Center, P.O. Box 868, Pittsburgh 30, Pennsylvania. J-22096

POWER-UP starts with CONTROL



YOU CAN BE SURE...IF IT'S Westinghouse

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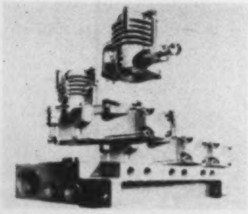
is available in counter-clockwise as well as clockwise movement. **Vibratory Feeder Co., div. of Automation Devices Inc.**, Erie, Pa.

Circle 455 on Page 17



4-Way Control Valve

Item 456

Unit is designed for control of smaller devices. Plug-in type valve features aluminum bodies, manifolds or sub-bases, end caps, spacers and pistons; hard chrome plated stainless steel stems; stainless steel shock pads, and O-ring packers. Solenoid pilots are interchangeable between single and double solenoid types, and all standard valves. No springs are used in the main valve body; pilot plungers and valve stem are the only moving parts in the unit.

Valves are available with solenoid coils for ac or dc, and for 30-250 psi air service. Manual over-ride for use during machine set up is optional. Foot mounted types are also offered. **Valvair Corp.**, 454 Morgan Ave., Akron, Ohio.

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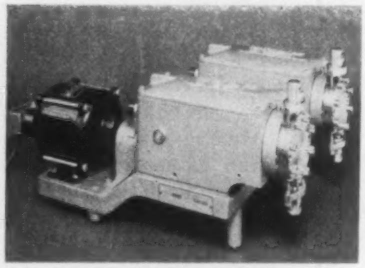

Duplex Pump

Item 457

Machine is capable of precision pumping, feeding, and proportioning of liquids at micro flow rates. Model LD is designed for pumping two liquids in equal volume, or each at a different rate but in exact ratio. Outfit includes an assembly of two piston-diaphragm pumps mounted side by side on a common base, with a single drive. The product is isolated from all pumping parts by a hydraulically balanced diaphragm, and is protected from contamination and leakage to atmosphere. The pumps have no stuffing box, packing gland, or running seal to come in contact with liquid being pumped.

Pumping rate is adjusted separately for each side and is hand set on a dial indiactor calibrated in 1000 increments. Setting can be adjusted in infinite increments while the pump is idle or operating, and has a range of zero to 100 per cent capacity. Units are available in two sizes, rated for pressures to 1000 psig with a maximum flow rate of 2300 ml per hour and pressures to 2000 psig with a maximum flow rate of 1040 ml per hour. **Process Equipment Div., Lapp Insulator Co. Inc.**, LeRoy 4, N. Y.

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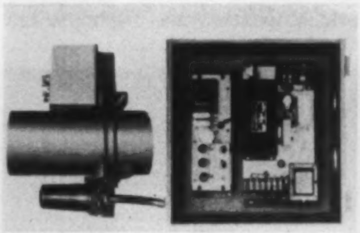


Density Control

Item 458

Device measures density of any process material passing through a pipe, either vertically or horizontally. Unit cannot be affected by corrosive materials, as no part of the equipment comes in contact with the process materials. Model JSP-173A requires no drilling of holes or welding of brackets; can easily be removed for use in another location. Instrument has a twofold function. When used with a satisfactory controller, it can provide accurate control of density within very close limits. When used with a recorder, it can indicate changes in specific gravity, interface level of different materials, and solids content in liquids from 1 to 25 per cent. **Instruments Inc.**, 122 N. Madison, Tulsa, Okla.

Circle 458 on Page 17

THOMAS JAK TUNG SYSTEM

"JOB-SUITED" to TRUCK, STORE and SPOT your loads WITHOUT REHANDLING

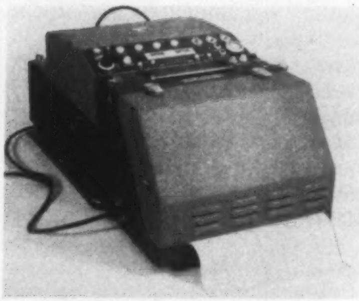
WRITE FOR CATALOG NO. JT-53

THOMAS TRUCK & CASTER CO.
806 Mississippi River • Keokuk, Iowa

THOMAS MAKES ALL KINDS OF TRUCKS, SKIDS, CASTERS AND WHEELS

THOMAS
THOMAS JAK TUNG

Circle 698 on Page 17



Photographic Processor

Item 459

Device can be attached to standard oscillographs, will provide developed and dried photographic records as fast as the instrument records data. Model 5-036 uses a high speed system of flash-processing; it chemically develops an oscillogram at rates up to 25 ips. A wide range of materials can be used. With a nominal capacity of 400 ft of 12-inch paper, magazine processor provides high information-capacity for long recording runs. Unit is provided with a separate cord and plug, can be operated from any 115v, 60 cycle power source. **Consolidated Electrodynamics Corp.,** 300 N. Sierra Madre Villa, Pasadena, Calif.

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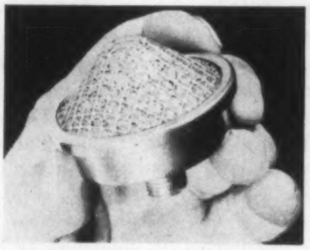


Air Exhaust Silencer

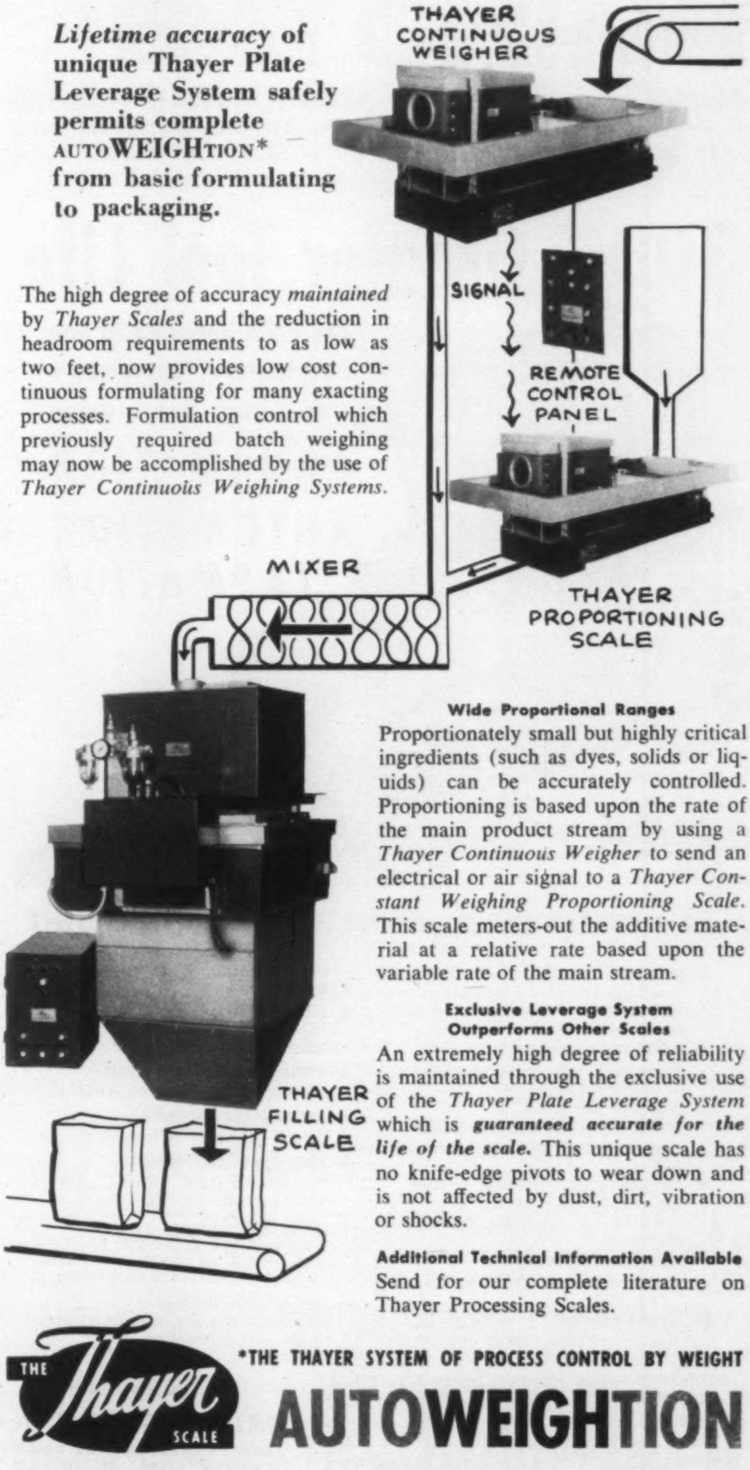
Item 460

Device lessens objectionable noise from air exhausts without impairing efficiency of air-operated equipment. It breaks up shock waves created when exhausting compressed air to atmosphere. Unit is a compact, self-contained assembly that mounts directly on any discharge port or piping by means of a standard pipe thread. Silencer is applicable to all types of air and vacuum devices such as air-operated chucks, holding devices, feeders, air motors, pneumatic tools, actuators, hoists, and

CONTINUOUS FORMULATING
with accuracy of ± ½%

***Lifetime accuracy* of unique Thayer Plate Leverage System safely permits complete AUTOWEIGHTION* from basic formulating to packaging.**

The high degree of accuracy *maintained* by *Thayer Scales* and the reduction in headroom requirements to as low as two feet, now provides low cost continuous formulating for many exacting processes. Formulation control which previously required batch weighing may now be accomplished by the use of *Thayer Continuous Weighing Systems.*



Wide Proportional Ranges

Proportionately small but highly critical ingredients (such as dyes, solids or liquids) can be accurately controlled. Proportioning is based upon the rate of the main product stream by using a *Thayer Continuous Weigher* to send an electrical or air signal to a *Thayer Constant Weighing Proportioning Scale.* This scale meters-out the additive material at a relative rate based upon the variable rate of the main stream.

Exclusive Leverage System Outperforms Other Scales

An extremely high degree of reliability is maintained through the exclusive use of the *Thayer Plate Leverage System* which is ***guaranteed accurate for the life of the scale.*** This unique scale has no knife-edge pivots to wear down and is not affected by dust, dirt, vibration or shocks.

Additional Technical Information Available

Send for our complete literature on Thayer Processing Scales.

THE Thayer SCALE

*THE THAYER SYSTEM OF PROCESS CONTROL BY WEIGHT

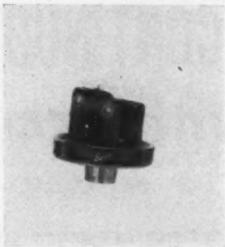
AUTOWEIGHTION

THE THAYER SCALE CORP., 5 Thayer Park, Pembroke, Mass.

Circle 699 on Page 17

similar mechanisms. It is also suitable for use on vacuum pumps and small gas engines. Silencer is available in five pipe sizes from ⅛ to ¾ inch. **Air-Maze Corp.,** 25000 Miles Rd., Cleveland 28.

Circle 460 on Page 17



Pressure Switch

Item 461

Designed for use in machine tool control panels, hydraulic test stands and lubrication systems, switch is designated Model GIS-8000. The pressure sensing chamber is sealed and contains a diaphragm of suitable material for use with a variety of fluids and gases. Switch can make or break electrical loads of 110/220v to 15 amp in response to pressure changes up to 225 psi. Burst pressure is 600 psi. **Gorn Electronics Div., Gorn Electric Co. Inc.,** 845 Main St., Stamford, Conn.

Circle 461 on Page 17

300% Greater Tool Life

has been obtained in one automotive company's crankshaft dept. using

DRILLMATION AUTOMATION TAPMATION

Model 1000 D-H Drilling Machine

12 NECESSARY, *Exclusive* FEATURES IN 1 UNIT

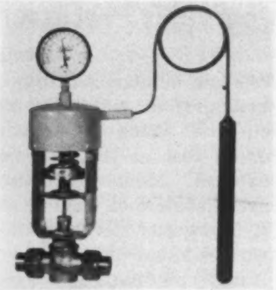
- **DULL TOOL CONTROL** Unit will withdraw tool from work and indicate to operator when tool becomes dull.
- **RAPID TOOL CHANGE** Tool may be replaced without changing the controls.
- **UNIFORM TIME CYCLE** Maintains comparatively constant time cycle even when tools become dull.
- **SELF-CONTAINED HYDRAULIC SYSTEM** Delivers only the oil pressure required to overcome machining resistance.
- **COMPLETELY AUTOMATIC** Enclosed electric controls. Unit is "Fail Safe".
- **THRUST CONTROL** Maximum thrust may be set to protect tools. Will not surge at break point.
- **FEED CONTROL** Infinitely variable and positive feed rate.
- **RAPID APPROACH AND RETURN** Variable irrespective of RPM.
- **MICRO DEPTH CONTROL** Depth will repeat within .0005 inch.
- **EMERGENCY QUILL RETURN** Button on front of unit. Aid in setting tools.
- **COOL OPERATION** Low volume high pressure hydraulic pump used on power stroke only. Air power used for rapid traverse.
- **PRODUCTION MACHINE** Mount in any position. Quiet operation. Self lubricating.

DRILLMATION

"FOR THE HOLE FIELD"

DRILLMATION CO.
6500 E. ELEVEN MILE ROAD
CENTER LINE, MICHIGAN
JEfferson 9-2030

Circle 700 on Page 17

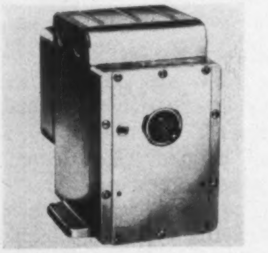


Temperature Regulator

Item 462

Adaptable for use in metal finishing processes, unit can provide accurate temperature regulation in plating, bonderizing, anodizing, cleaning, pickling, and rinsing solutions. Special metals and plastics used in Model PA-2 give a long operating life and dependable performance. A hand wheel adjusts temperatures within the limits of a selected range. Unit is available in seven valve sizes from ¼ to 1½ inch. Various bulb sizes are also furnished. **Fulton Sylphon Div., Robertshaw-Fulton Controls Co.,** Box 400, Knoxville, Tenn.

Circle 462 on Page 17

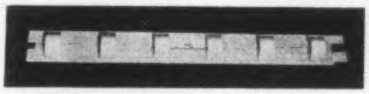


Motor Operator

Item 463

Device is an oil-submerged, spring return, proportional type electric motor operator designed to control dampers in heating, ventilating, and air conditioning systems. Motor features a gear train and drive completely submerged in oil and sealed in a die-cast case. It can be mounted in any position. Auxiliary switches are readily accessible and simple to adjust. Its output shaft is power operated in both directions to position a controlled device as required and maintains this position when power is on, with an internal holding circuit. Enclosed spring return drives controlled device to its normal position on a power interruption. Units are available for 24, 115, 208, and 230v. Accessories which can be furnished are a two or four section switch kit for control of auxiliary circuits, a potentiometer kit for use on self balancing ac bridge applications, and a rear shaft kit for small damper operation. **Barber-Colman Co.**, 1300 Rock St., Rockford, Ill.

Circle 463 on Page 17



Magnetic Rails

Item 464

When rails are fastened under belt conveyors, units are transformed into magnetic conveyor-elevators, capable of handling ferrous materials and parts up inclines as steep as 90 degrees with positive control. Items such as tin cans, metal parts, assemblies, sheets, and nails are conveyed at high speed. Magnetic rails can also be installed to permit materials to be conveyed suspended from the lower belt surface.

Line of rails is available in three different strengths. The single transition section, starting at the bend line, curves on a 15-inch radius for a distance of 80 degrees. The tips of the discharge end bend to a sharper radius so that conveyed material can leave the magnetic field gradually instead of abruptly. Transition sections are furnished as an integral part of the selected straight rail unit preceding it. All units are so constructed that when they are mounted end to end, using flat-head bolts, they will automatically have

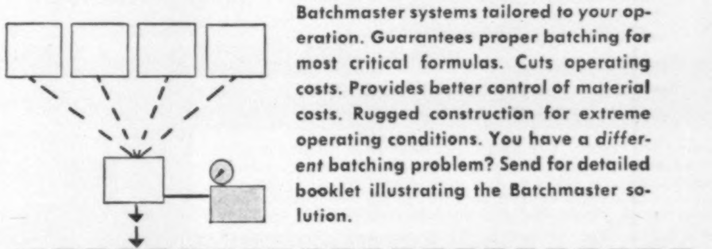
PUSH BUTTON BATCHING

BATCHMASTER speeds automatic processing

At last, completely automatic one-man batching for you. Batchmaster is the simple, speedy system for precise mixing of multiple ingredients to any desired formula. Accommodates all materials — solid, powdered, granulated, liquid. Provides *continuous* automatic control of all ingredients by weight. Boosts production, improves quality control, eliminates waste.

No need for expensive, complex custom installations. Howe engineers *standard* Batchmaster systems tailored to your operation. Guarantees proper batching for most critical formulas. Cuts operating costs. Provides better control of material costs. Rugged construction for extreme operating conditions. You have a *different* batching problem? Send for detailed booklet illustrating the Batchmaster solution.

Simply dial the formula and mixing times, select number of batches, and press start button. Any number of ingredients are automatically fed, weighed, mixed and discharged.



Write for Complete Details

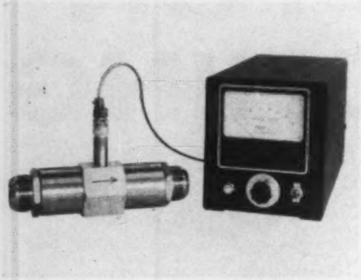
HOWE

THE HOWE SCALE CO. · RUTLAND, VERMONT
A SUBSIDIARY OF SAFETY INDUSTRIES, INC.

Circle 701 on Page 17

correct polarity. For use with corrosive liquids or atmospheres, stainless steel units can be furnished. **Eriez Mfg. Co.,** Erie 6, Pa.

Circle 464 on Page 17



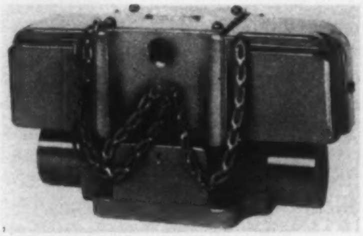
Turbine-Type Flowmeter

Item 465

Flowmeter can measure jet fuel, gasoline, oil, water, chemicals, and other liquids over a wide range of temperature and pressure conditions. Pressures up to 5000 psi are accommodated at temperatures ranging from −80 to 1000F. Line of meters designated Type 20 has accuracy of ±½ per cent of any reading over the 10:1 range of the instrument. Repeatability is ±0.1 of 1 per cent.

Instrument includes a stainless steel housing, a precision turbine wheel suspended in the housing, two flow straightening assemblies, and a magnetic pickup coil. Fluid passing through the turbine causes it to revolve at a speed directly proportional to the fluid velocity. As each blade of the turbine passes the pickup, it interrupts the magnetic field of the coil, producing an ac signal. Since the rotational speed of the turbine wheel is directly related to fluid velocity, the frequency of the signal is proportional to the volumetric rate of flow. The signal so produced is then fed directly into a counting type indicator, or converted to a dc voltage for use with a continuous reading indicator. Indicator shown (Model 7) can be calibrated either in gpm or pounds per hour and has an accuracy of ±1 per cent. Flowmeters are available in 12 sizes, with capacities ranging from 0.25 to 125 gpm. **Commerical Research Div., George L. Nankervis Co.,** 15300 Fullerton Ave., Detroit 27, Mich.

Circle 465 on Page 17



4-Way Valve

Item 466

Compact size of ⅜-inch unit requires little space and has greater flow capacity. Small solenoids in valve are same as used in company's ⅛ and ¾ inch models, and they can be used throughout circuit where different sized valves are used. Surges in tank line cannot affect valve operation because of a seal drain design. Control of the speed of spool traverse provides smooth shifting. Valve capacity is 8 gpm and maximum operating pressure 2000 psi. Eleven spool modifications are available, including a tandem type. **Double A Products Co.,** Manchester, Mich.

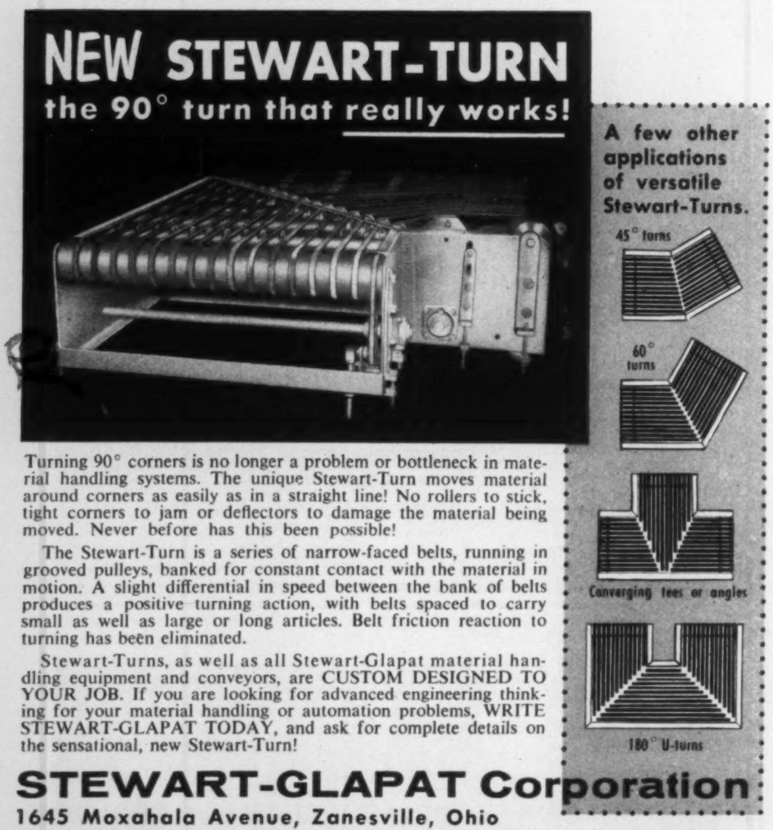
Circle 466 on Page 17

Silicon Rectifier

Item 467

Unit is capable of handling up to 20 amp at case temperatures of 135C. Rectifiers cover the range of 50 to 350v peak inverse, and can be used under severe environmental conditions of moisture and vibration fatigue, high acceleration vibration, centrifuging, shock and temperature cycling. They can be operated at ambient temperatures ranging from −50C to +165C, and stored at temperatures ranging from −65C to +180C. Rectifiers are available in current ratings of 5, 10, and 20 amp, with peak inverse voltages of 50, 100, 150, 200, 250, 300, and 350. **Automatic Manufacturing Div., General Instrument Corp.,** 65 Gouverneur St., Newark 4, N. J.

Circle 467 on Page 17


A few other applications of versatile Stewart-Turns.
45° turns
60° turns
Converging tees or angles
180° U-turns

NEW STEWART-TURN
the 90° turn that really works!

Turning 90° corners is no longer a problem or bottleneck in material handling systems. The unique Stewart-Turn moves material around corners as easily as in a straight line! No rollers to stick, tight corners to jam or deflectors to damage the material being moved. Never before has this been possible!

The Stewart-Turn is a series of narrow-faced belts, running in grooved pulleys, banked for constant contact with the material in motion. A slight differential in speed between the bank of belts produces a positive turning action, with belts spaced to carry small as well as large or long articles. Belt friction reaction to turning has been eliminated.

Stewart-Turns, as well as all Stewart-Glapat material handling equipment and conveyors, are CUSTOM DESIGNED TO YOUR JOB. If you are looking for advanced engineering thinking for your material handling or automation problems, WRITE STEWART-GLAPAT TODAY, and ask for complete details on the sensational, new Stewart-Turn!

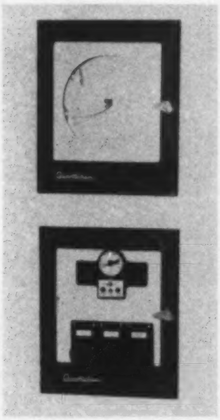
STEWART-GLAPAT Corporation
1645 Moxahala Avenue, Zanesville, Ohio

Circle 702 on Page 17

Water Analyzer

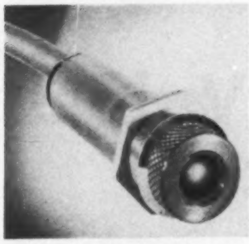
Item 468

Instrument can continuously analyze water for total hardness or silica concentration. Each analysis is on a fixed time cycle with the results recorded on a separate unit that can include alarms or control devices. The analyses are based on the effects silica or hardness-causing calcium and magnesium ions have on specific reagents which change the amount of light that a given volume of sample solution will absorb or transmit. The difference in the amounts of light transmitted through a zero cell and a test cell is measured photoelectrically, and because the difference is proportional to the concentration of silica or hardness, the instruments are calibrated to read in units of concentration.



Unit automatically performs all steps of an analysis from the flushing of the sample cells and calibration of the photoelectric measuring circuit to the metering of reagents and the recording of the results. When the analysis is completed, the unit starts testing a new sample. Each silica test takes 12 minutes; each hardness test 6 minutes. Recorders are equipped with adjustable High-Low limit switches that can be set at any value within the instrument range. The analyzers are automatically calibrated in each cycle and pilot lamps flash when the cells must be cleaned or the light source replaced. Water to be tested must be available at pressures above 10 psi and temperatures below 100F. **Milton Roy Co.,** 1300 E. Mermaid Lane, Philadelphia 18, Pa.

Circle 468 on Page 17



Light Beam Projector

Item 469

Unit can be mounted in a single 11/16-inch diameter hole, is suitable for close-proximity use with miniature photoelectric cells. Model 6375 is designed as a companion for Model 6350 miniature photoelectric unit. Projector operates on a nominal 0.15 amp input of 6.3v ac or dc. Removal of the knurled protective ring allows access to the miniature bayonet base lamp. **Autron Engineering Inc.,** 1254 W. Sixth St., Los Angeles 17, Calif.

Circle 469 on Page 17

STANDARD SETS THE PACE in MILLING SPINDLES

No. 6027 MY Motor Driven

No. 6009 M Motor Driven

No. 4207 M Belt Driven

Meet America's BIG LINE!

We're proud of our position of leadership in the field of spindles for milling applications — a leadership which is the result of nearly five decades of experience in the spindle field. For our customers, it means a milling spindle for every purpose — a complete line of master-crafted super-precision units with which the designer can meet the requirements of any milling job!

From 1 to 200 HP with standard tapers, #10 to #60. To satisfy every milling demand — enclosed, totally enclosed fan-cooled, high cycle and liquid-cooled. Motorized or Belt-Driven. Variable, single or multiple speed motor — Speed to suit your application.

FOR COMPLETE SPECIFICATIONS AND DIMENSION DRAWINGS OF MORE THAN 75 MILLING SPINDLES, WRITE TODAY!

SUPER PRECISION SPINDLE DIVISION
the STANDARD electrical tool co. SINCE 1912
SPINDLES AND MACHINE TOOLS

STANDARD Since 1912 HALLMARK OF METALWORKING THROUGHOUT THE WORLD

2550 RIVER ROAD • CINCINNATI 4, • OHIO

Circle 703 on Page 17

HERE'S ONE — MORE TO COME

New Skinner Valves at Low Prices

Here it is — one of the many new lines Skinner will bring you in 1958. A new 2-way, normally closed, pilot-operated valve that is lighter in weight — only 1 ¾ pounds — and smaller in size, yet permits full flow through a ½" orifice with ⅜" or ½" pipe taps.

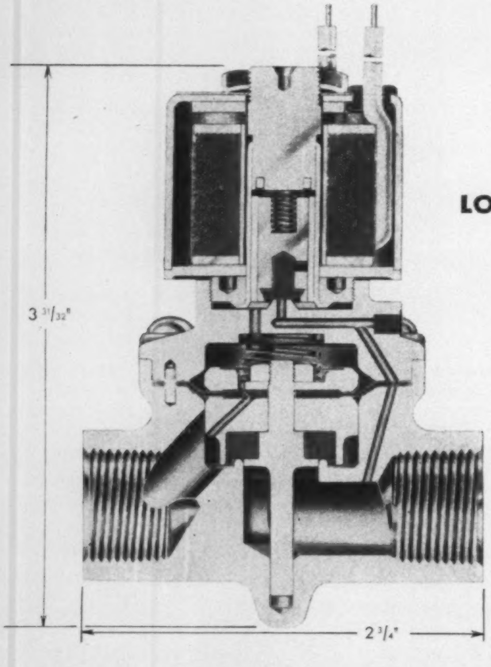
The valve handles pressures from 5 psi to 150 psi, with temperature ranges from —40°F to 180°F, and will operate on all popular AC and DC voltages. It's small but rugged, economical but efficient — manufactured to the highest engineering standards of the Skinner Valve line.

Versatility is also a feature of the new Skinner L Series; modifications are already available for normally open operation, with such options as manual override, explosionproof construction and choice of electrical connections to fit your application requirements.

* * *

You can get full details of this exciting, new valve line by writing us direct or by contacting the Skinner Representative or Distributor near you. He's listed in the Yellow Pages. Write Dept. 321.

2-way normally closed shown actual size.



LOOK AT THESE HIGH-QUALITY FEATURES:

- Unique Diaphragm Design — by actual test, this new design outperforms all others — the diaphragm is completely supported at all times. The nylon-reinforced buna diaphragm has a high resistance to media impurities, and only a small area is exposed to pressure, which assures long, trouble-free life.
- So Easy to Mount — so light in weight that it can economically mount directly to line.
- Operates upside down, sideways, in any position — strong spring action snaps valve shut — every time.
- Forged Brass Body — provides low porosity and dense metal structure for rugged application and no leakage.
- Low Wattage Consumption — coil consumes only 8 watts, considerably less than comparable valves.
- Soft, Synthetic Inserts — withstand constant opening and closing of pilot and main orifices — are long-wearing and provide absolute bubbletight operation.
- Internal Stainless Steel Parts — eliminate internal rusting, clogging or contamination.

SKINNER · ELECTRIC VALVES

THE CREST OF QUALITY

SKINNER ELECTRIC VALVE DIVISION
NEW BRITAIN CONNECTICUT
105 EDGEWOOD AVENUE

catalogs and literature

Latest automation information. For copies use card page 17.

Silent Chain Drives

Link-Belt Co., Dept. PR, Prudential Plaza, Chicago 1, Ill.—88 *page handbook*—Engineering data on line of chains are given in Catalog 2425. Tables of service factors, ratings, chain length and center distance computations are noted. Another section lists available chain widths, chain and wheel dimensions, wheel tolerances, and materials. Illustrative examples of applications from fractional horsepower drives to huge horsepower drives are included.

Circle 470 on Page 17

Turning Rolls

Aronson Machine Co., Arcade, N. Y.—12 *page booklet*—Tank turning rolls, pipe rolls, and rail cars for positioning cylindrical vessels for automatic welding are described in Bulletin TR 57. Diameter settings, speeds, tire sizes and tractive pull ratings for unbalanced vessels are given.

Circle 471 on Page 17

Numerical Control Table

Pratt & Whitney Co. Inc., Charter Oak Blvd., W. Hartford 1, Conn.—2 *page pamphlet*—A rotary table equipped with numercial control for automatic indexing is described. Operating principle and features of the unit are discussed. How planning chart data can be fed into the table by punch tape or an operator's console is also explained.

Circle 472 on Page 17

Core Ovens

Foundry Equipment Co., Dept. 10D, 1831 Columbus Rd., Cleveland 13, Ohio—8 *page bulletin*—Line of dielectric core ovens is described in Bulletin 657. A chart listing engineering data and dimensions on 14 standard models with rated output capacity ranging from 30 kw to 200 kw is given. Photo of the largest core oven, which cures 8000 lb of cores hourly, is shown. Numerous illustrations of installations of the ovens in all types of foundries are included.

Circle 473 on Page 17

Filters

Millipore Filter Corp., Publications Dept., 36 Pleasant St., Watertown 72, Mass.—16 *page booklet*—Physical and chemical characteristics of the Millipore filter are explained. Industrial applications involving servomechanisms and ultrasonic cleaning are described. Specifications and prices on all types of filters, filter holders, and field apparatus are listed.

Circle 474 on Page 17

Special Industrial Machinery

Lake Erie Machinery Corp., 1001 Woodward Ave., Buffalo 17, N. Y.—16 *page booklet*—Facilities for the manufacture of special industrial machinery are described in Bulletin 157. Equipment available for designing, machining, assembly, and testing of new industrial machinery is covered and illustrated.

Circle 475 on Page 17

Wire Stitchers

Bostitch Inc., Westerly, R. I.—12 *page booklet*—Container stitchers, top stitchers, bottom stitchers, and box stitchers are covered. Descriptions and illustrations of the various models in each line are included.

Circle 476 on Page 17

Automatic Packaging Units

Wright Machinery Co., Div. of Sperry Rand Corp., Durham, N. C.—32 *page handbook*—Packaging and weighing machines for various products are described. Units for handling dry products such as potato chips and pretzels; free flowing products such as candy, cookies, and crackers; and free flowing products which are packaged in glass or tin cans are covered. Suggestions for an automatic cartoning and weighing system are also given.

Circle 477 on Page 17

Bending Machines

Wallace Supplies Mfg. Co., 1300 Diversey Parkway, Chicago 14, Ill.—34 *page handbook*—Illustrative booklet shows various applications of three types of bending machines—rotary, ram, and roll. Features and advantages of the machines are given.

Circle 478 on Page 17

Circuit Analyzer

Electronics Div., Dit-Mco Inc., 911 Broadway, Kansas City 5, Mo.—22 *page booklet*—Data on line of automatic circuit analyzers are given. Various models are illustrated and instructions, applications, and specifications are given for each. Diagrams and charts showing operational features are also noted.

Circle 479 on Page 17

Combustion Control System

Hagan Chemicals & Controls Inc., Hagan Bldg., Pittsburgh 30, Pa.—8 *page bulletin*—Detailed information on the components that make up the combustion control system, which is applicable for marine boilers, is given in Bulletin MSA-144. Schematic drawings of the master sender, boiler relay, damper operator, air-fuel ratio regulator, and oil control valve are included.

Circle 480 on Page 17

Conveyor/Transmission Belting

Boston Woven Hose & Rubber Co., div. of American Biltrite Rubber Co. Inc., P. O. Box 1071, Boston 3, Mass.—4 *page pamphlet*—Balanced belt construction, a method of manufacturing conveyor and transmission belting, is discussed. Advantages of this method are noted and a diagram of the construction of the belt included.

Circle 481 on Page 17

Lifter-Dumper

Essex Conveyors Inc., 165 *Franklin Ave., Nutley* 10, *N. J.*—8 *page bulletin*—Line of multipurpose dumpers is described. Instructional photos show how the equipment can be used to handle bags, boxes, bulk, drums, and free flowing material. A motor operated dumper for lifting and dumping loads up to 400 lb is also covered.

Circle 482 on Page 17

Pinch Type Valves

RKL Valve & Mfg. Co., Route 38 *& Rudderow Ave., Maple Shade, N. J.*—16 *page booklet*—Various types of pinch valves such as hand operated, air operated, and pistol grip are described in Catalog 857. Engineering data, dimensions, and advantages are covered. Photos and schematic drawings of some of the models are also included.

Circle 483 on Page 17

Remote Weighing

Toledo Scale Co., Toledo, Ohio—8 *page bulletin*—Devices which transmit weight readings to any remote location and record or indicate the weight in digital form are described. The digital scanner system used in these devices is explained in Bulletin 2975. Operating principle and advantages of the electronic load cell scale are covered in Bulletin 2970.

Circle 484 on Page 17

Pneumatic Computers

Minneapolis - Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44 *Pa.*—8 *page bulletin*—Computing device for square root extraction, ratio setting, division and multiplication in pneumatic measurement or control circuits is discussed in Bulletin C80-1. Operation and applications are noted and diagramed, and specifications given.

Circle 485 on Page 17

Rotary Car Dumper

Heyl & Patterson Inc., 55 *Fort Pitt Blvd., Pittsburgh* 22, *Pa.*—16 *page booklet*—Car dumper which is applicable in the steel, coal, and cement industries is described in Bulletin 957. Operating principle and design features are explained. Also included is a cutaway view of the dumper showing placement of the various components.

Circle 486 on Page 17

Turbine Flow Meter

Fischer & Porter Co., 75 *Jacksonville Rd., Hatboro, Pa.*—8 *page bulletin*—Device which gives precise measurement of liquid flow is described in Bulletin 10C150. Operating principle is explained, and advantages listed. Indicators, totalizers, and data loggers which can be used with the flow meter are illustrated and discussed.

Circle 487 on Page 17

Hand Lift Trucks

Association of Lift Truck & Portable Elevator Mfrs., Suite 759, *One Gateway Center, Pittsburgh* 22, *Pa.*—16 *page booklet*—The uses of hand lift trucks in industrial materials handling systems are explained. Booklet covers two types of hand lift trucks: skid type and pallet type. It discusses what they are, how they operate, how to select and use them. Basic principles of single or multistroke mechanical lifting mechanisms are also mentioned.

Circle 488 on Page 17

Radiant Heating Equipment

Fostoria Pressed Steel Corp., Fostoria, Ohio—8 *page bulletin*—Radiant heating equipment for metal processing is described in Bulletin 57-108. Suggested combinations of the units for efficient infrared ovens are given. Eighteen illustrations of various applications are given.

Circle 489 on Page 17

Metal Stitching

Acme Steel Co., 135*th St. & Perry Ave., Chicago* 27, *Ill.*—16 *page booklet*—Machine which stitches metal to metal or metal to non-metal is described. Stitchable materials and combinations are mentioned. Illustrations of various applications are also included.

Circle 490 on Page 17

Liquid Level & Flow Controls

Magnetrol Inc., 2110 *S. Marshall Blvd., Chicago* 23, *Ill.*—10 *page bulletin*—Liquid level control applications in an experimental boiling water reactor are described. A flow diagram is included and an explanation of the function of each part is given. Illustrations of components on various models are noted.

Circle 491 on Page 17

Worm Gears

Cone-Drive Gears, div. of Michigan Tool Co., 7171 *E. McNichols Rd., Detroit* 12, *Mich.*—24 *page handbook*—Data on the design and application of double-enveloping worm gears is given in Bulletin CD-200. Instructions for proper use in applying gears to drives of all types are noted. Correct lubrication is also discussed.

Circle 492 on Page 17

Hydraulic Fluids

Vickers Inc., Box 302, *Detroit* 32, *Mich.*—24 *page handbook*—The selection, operation, and maintenance of hydraulic fluids for industrial machinery is discussed in Bulletin 1300SA. Viscosity recommendations, prevention of rust and corrosion, and reservoir requirements are a few of the subjects covered.

Circle 493 on Page 17

Mill Automation

Richardson Scale Co., Van Houten Ave., Clifton, N. J.—12 *page booklet*—Reprint of a technical report describes digital printout techniques for automatic proportioning control. Techniques which are applicable for weight selection by potentiometer, servo supervision of feeder motors, digital computing for printout and totalizing, and electrical sequencing and interlocking are explained.

Circle 494 on Page 17

Automatic Welding Machines

Dix Engineering Co. Inc., 1415 *Dix Rd., Lincoln Park* 25, *Mich.*—6 *page pamphlet*—Welding problems met in manufacturing automatic transmission, drive tube, rear quarter panel, and bumper guard assemblies are discussed. Illustrations of welding machines built for special jobs are shown.

Circle 495 on Page 17

Packaged Pneumatic Units

Renco-Toledo Inc., 3358 *Alexis Rd., Toledo* 13, *Ohio*—4 *page pamphlet*—Data such as descriptions, applications, and specifications on the pneumatic rotary automatic unit, push-pull automatic unit, and automatic drill press feeds are given in Bulletin 101. Units can convert existing machines to automatic production equipment. Accessories for the pneumatic units are also noted.

Circle 496 on Page 17

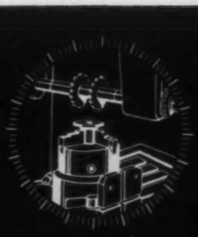
Control Systems

Powers Regulator Co., 3434 *Oakton St., Skokie, Ill.*—64 *page handbook*—Textile processing systems and equipment for control of temperatures of size cooking and storage kettles, size boxes, overwaxers, and slashers are described. Level control systems for size boxes and cookers are also covered. Data on pneumatic relays, valves, and thermome-

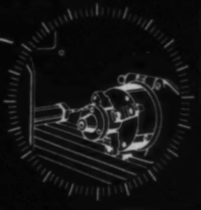
NEW ERICKSON MASTER SPACER

with No. 0 Timken Bearings

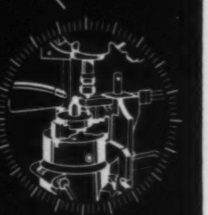
gives increased production and optimum accuracy in



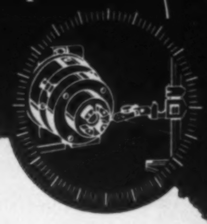
straddle milling



milling



jig drilling
with either micrometer or "Jo" block setting



inspection

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SPACER

The new Erickson Master Spacer quickly and accurately positions work for a wide variety of jobs. This *one* tool can eliminate expensive jigs and fixtures . . . makes it a simple procedure to set up drilling, milling, boring and special machining operations.

The new Erickson Master Spacer, ideal for tool room and production machining, assures outstanding performance under heavy helical cuts and slow feeds. *Indexing accuracy guaranteed within .001-inch cumulative error on a 6-inch diameter circle.* Jig drilling is possible with either micrometer or "Jo" block setting. Timken bearing construction permits work to be trued in position with brake off because spindle alignment remains unchanged.

The new Erickson Master Spacer can help you come to grips with your Number One Problem—high production costs. The first step is to get the Erickson story.

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COLLET CHUCKS • FLOATING HOLDERS • TAP CHUCKS • TAP HOLDERS • AIR-OPERATED CHUCKS
EXPANDING MANDRELS • EXPANDING-COLLETS • SPECIAL HOLDING FIXTURES

Circle 705 on Page 17

ters is included. Illustrations on various regulators are given, their construction and operation explained.

Circle 497 on Page 17

Steel Tubing

Ohio Seamless Tube Div., Copperweld Steel Co., Shelby, Ohio—*8 page bulletin*—Seamless and electric resistance welded steel tubing in mechanical, aircraft mechanical and pressure grades is described in Bulletin CS-58. The fabricating and forging of steel tubing into special shapes and parts is also explained.

Circle 498 on Page 17

Adhesive-Bonding Machines

Modern Industrial Engineering Co., 14230 Birwood Ave., Detroit 38, Mich.—*6 page pamphlet*—Line of machines for assembling parts of various materials by adhesive bonding is described in Bulletin CB-1. Construction, sizes, and operating characteristics of the units are noted.

Circle 499 on Page 17

Fasteners

Huck Mfg. Co., 2480 Bellevue Ave., Detroit 7, Mich.—*16 page booklet*—Data such as material, heat treatment, driving cycles, finishing specifications, and strength properties for two types of aircraft fasteners is covered in Bulletin 8-411. Various pneumatic, hydraulic, and manual driving tools for inserting the fasteners are described and illustrated.

Circle 500 on Page 17

Induction Heater

Magnethermic Corp., 3990 Simon Rd., Youngstown, Ohio—*8 page bulletin*—60-cycle induction heaters for aluminum, copper, brass, and steel are described. A billet heater selection chart for aluminum, and a frequency selection chart for steel bar stock is included. Production arrangements for various requirements are suggested.

Circle 501 on Page 17

Plate Magnet

Stearns Magnetic Products, 635 S. 28th St., Milwaukee 46, Wis.—*8 page bulletin*—Line of plate magnets used for removing tramp iron from flowing material in chutes, spouts, ducts, or on conveyors is described in Bulletin 1071-P. Performance charts are given and graphs showing how to select the exact type and size of plate magnet for a particular installation is included.

Circle 502 on Page 17

Conveyor Systems

West Bend Equipment Corp., 370 Water St., West Bend, Wis.—*8 page bulletin*—Automatic vertical and horizontal transportation is described in Bulletin E-557. Operating sequence and features are explained. Suggested flow patterns and plans are also given.

Circle 503 on Page 17

Worm Gear Speed Reducers

Jones Machinery Div., Hewitt-Robins Inc., 666 Glenbrook Rd., Stamford, Conn.—*40 page catalog*—Line of worm gear speed reducers is described in Bulletin J13. Reducers with power ratings ranging from less than 0.1 to 121 hp are covered. Drawings and specification tables showing dimensions and ratings for standard units are included.

Circle 504 on Page 17

Meters & Controls

Hays Corp., Michigan City, Ind.—*8 page bulletin*—Meters which indicate, totalize, and control liquids such as water, oils, sulphuric acid, and solvents are described in Bulletin 54-766-38. Construction, operating principle, and features are covered. A cut-away view of the flow operator is also included.

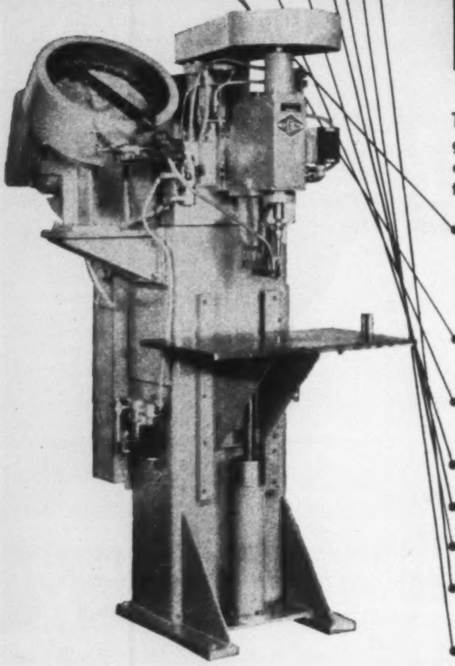
Circle 505 on Page 17

speed up your stud setting

with GRAY

heavy duty stud driving

MACHINE



Model STD-1

This rugged, new machine can give up to 630 lbs. in. of driving torque, according to the motor used.

- Drives: standard studs up to ⅝ in. dia.; Schweppe self-tapping studs and Tap-Lok inserts
- Has screw-on or self-opening drivers
- Available with single or multiple spindles
- Up to 3 hp spindle drive
- Air-hydraulic spindle feed
- Up to 1000 cycles per hour
- Studs automatically hopper fed
- Easily retooled for other applications

Write for Bulletin STD-1 and suggestions for engineering this versatile machine to your work. Gray can do the whole job for you.

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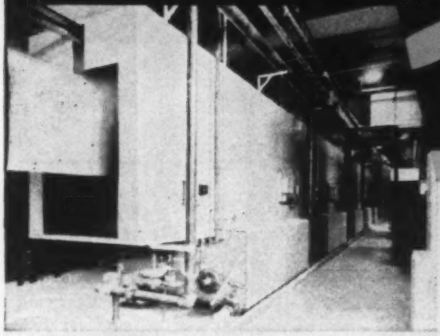
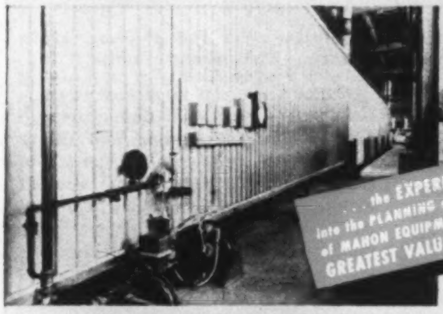
Circle 706 on Page 17

COMPLETE *Finishing* SYSTEMS

... for ENAMELS • LACQUER • PAINT • VARNISH

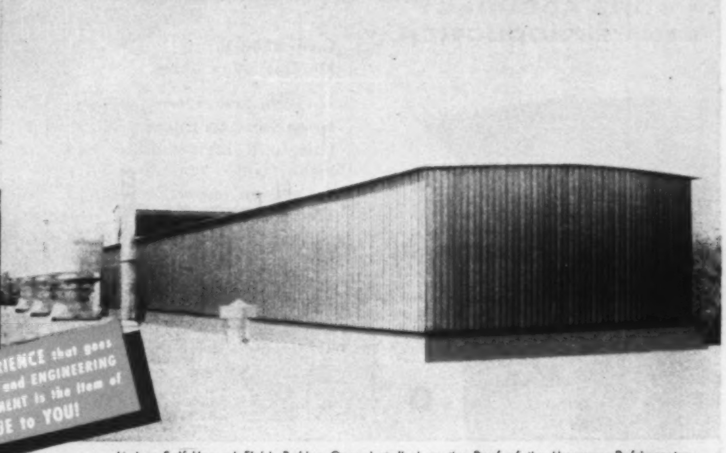


Mahon Five-Stage Metal Cleaning and Rust Proofing Machine—Part of the Complete New Mahon Finishing System at Hussmann.

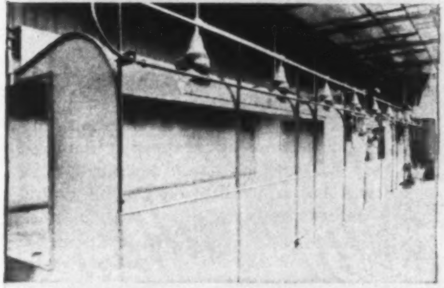


... the EXPERIENCE that goes into the PLANNING and ENGINEERING of MAHON EQUIPMENT is the item of GREATEST VALUE to YOU!

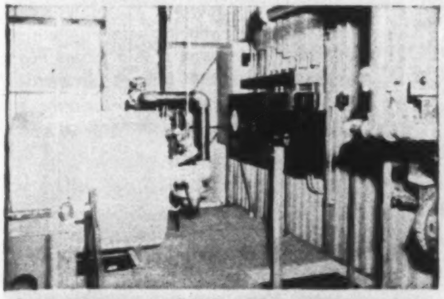
Mahon Dry-Off Oven at Exit End of Cleaning and Rust Proofing Machine. Oven Controls are visible in the foreground.



Mahon Self-Housed Finish Baking Oven installed on the Roof of the Hussmann Refrigerator Co. Plant. Air Intake, Filtered Air Supply Equipment and Heaters are Housed at the far end.



48 Ft. Mahon Hydro-Filter Spray Booth in foreground. Another 24 Ft. Spray Booth for reverse side painting is visible in the background. Note Filtered Air Diffusers in the Ceiling.



Equipment Room between Finish Baking Oven and Air Supply Room. This room houses Heating Equipment and Controls for both Units.

Mahon Installs THIRD COMPLETE FINISHING SYSTEM in Hussmann Refrigerator Plant!

In addition to several smaller projects, the Mahon Company has installed three Complete Finishing Systems for the Hussmann Refrigerator Co., St. Louis, Mo. The latest one, illustrated here, was designed to paint steel shelving. It consists of a five-stage Metal Cleaning and Rust Proofing Machine, a Dry-Off Oven, two Hydro-Filter Spray Booths, an Air Conditioned Spray Room, and a Finish Baking Oven. The Cleaning and Rust Proofing Equipment, Dry-Off Oven and Spray Room are located inside the plant; the Filtered Air Supply Equipment and the Finish Baking Oven are housed on the roof. This is a typical Mahon Finishing System designed to occupy a minimum of floor space inside the plant, and to do a particular finishing job efficiently and economically. Repeat orders from customers over a period of years is an unquestionable expression of confidence in the Mahon organization, and it is an unspoken tribute to Mahon engineering, and to the quality and operating efficiency of Mahon equipment. If you have a finishing problem, or are contemplating new finishing equipment, you, too, will want to discuss methods, equipment requirements and possible production layouts with Mahon engineers . . . you'll find them better qualified to advise you, and better qualified to do the all-important planning, engineering and coordinating of equipment, which is the key to producing the finest finishes at minimum cost. See Sweet's Plant Engineering File for information, or write for Catalog A-658.

THE R. C. MAHON COMPANY • Detroit 34, Michigan

SALES-ENGINEERING OFFICES in DETROIT, NEW YORK and CHICAGO

Engineers and Manufacturers of Complete Finishing Systems—including Metal Cleaning, Pickling, and Rust Proofing Equipment, Hydro-Filter Spray Booths, Dip and Flow Coaters, Filtered Air Supply Systems, Drying and Baking Ovens, Cooling Tunnels, Heat Treating and Quenching Equipment for Aluminum and Magnesium, and other Units of Special Production Equipment.

MAHON

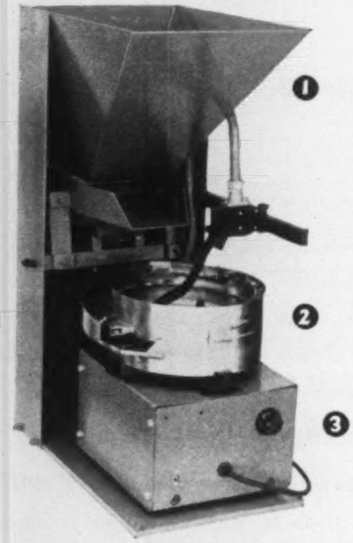
Circle 707 on Page 17

YOU GET MORE WITH

MOORE

Automation Equipment

- MORE SPEED
- MORE ACCURACY
- MORE PRODUCTION



1 MOORBIN

Automatic Storage Hopper

1/8-inch steel construction • Built-in vibrating feeder that will not jam • Maintains maximum feed rate which bowl will produce.

2 MOORBOWL

1/8-inch stainless steel construction • Bottom, track and output chutes are Heliarc welded • Sizes from 5-inch to 30-inch diameter.

3 MOORFEED-120

Vibrating Parts Feeder

120 cycles per sec. • Faster (up to 50 fpm.) • No rectifier required • Not necessary to remove covers to change bowls.

Moore equipment is available either as individual components or in complete package units with positioning devices. Package units can be supplied already tooled up or for tooling up in your own plant.

Write for further information or for our recommendations for your particular automation requirements.

MOORE
Equipment
Company

1216 EAST MICHIGAN STREET
INDIANAPOLIS 2, INDIANA

Circle 708 on Page 17

AUTOMATION problem forum

Readers with problems concerning systems, equipment or components for automated operations are invited to outline them to: The Editor, AUTOMATION, Penton Bldg., Cleveland 13, Ohio. Solution suggestions should refer to case number and title of the problem involved. Dates shown with suggestions indicate issue in which the problem was presented.

Case 1366-P
Molding Wax Tires

. . . We are interested in purchasing a machine to inject and mold a wax tire to a high-voltage flyback television coil. (Operation can be performed on one or several at a time.) We are manufacturers of this type coil and, at present, are handrolling the tire to the coil.

Details and specifications are: 1. Solder joints will be smooth—no sharp edges. 2. Tire must fit snugly all over, especially under high-voltage lead wire where it emerges from the coil. Tire must be free of all air pockets. 3. All taping will be smooth and flat with no curled edges. 4. High-voltage lead must be imbedded in wax and emerge from tire, having full tire thickness. 5. High-voltage winding will have maximum OD of 1.850 inches before tire is applied. 6. Tire must extend to within 5/32 inch, plus nothing minus 1/32 inch, of bushing (ID of high-voltage winding). 7. Wax used is Bi-Wax Corp. number 6698.

We would prefer that someone supply us with the mold (probably water-cooled) and the wax injection system, but if this service is not available, we would be interested in the wax injection system. Then we could probably build our own molds or have them built for us.

We will supply any interested party with samples and any further information they may require . . .

Senior Industrial Engineer

Suggestions For 1256-P (July 1957)
Lathe Loading and Unloading

. . . We are particularly interested in offering assistance to the parties involved in this case, with reference to automatically loading and unloading parts from engine lathes. . .

R. E. Hawkins
Seneca Falls Machine Co.

◆

. . . We wish to advise that we have developed similar devices for such companies as U.S. Steel and Hyatt Roller Bearing Co. We shall be glad to study this problem and submit a proposal. . .

Robert Kurzweil
Kurzweil Associates Inc.

◆ ◆ ◆

Suggestions For 1261-P (Aug. 1957)
Charging Thermostatic Units

. . . Our company manufactures automatic as well as semiautomatic machines for exhausting and filling thermostatic bellows. Enclosed is a copy of page 184 from our general catalog 45-CE which illustrates this particular type of equipment. We must have more information concerning the degree of vacuum before filling, also the type of filled gas and its pressure . . .

Charles Eisler Jr.
Eisler Engineering Co. Inc.

◆

. . . We are designers and manufacturers of automatic production machinery, and have recently handled a process such as is described. We will be happy to visit his plant and discuss the possibilities with him. . .

E. A. Underhill
ConRay Corp.

◆

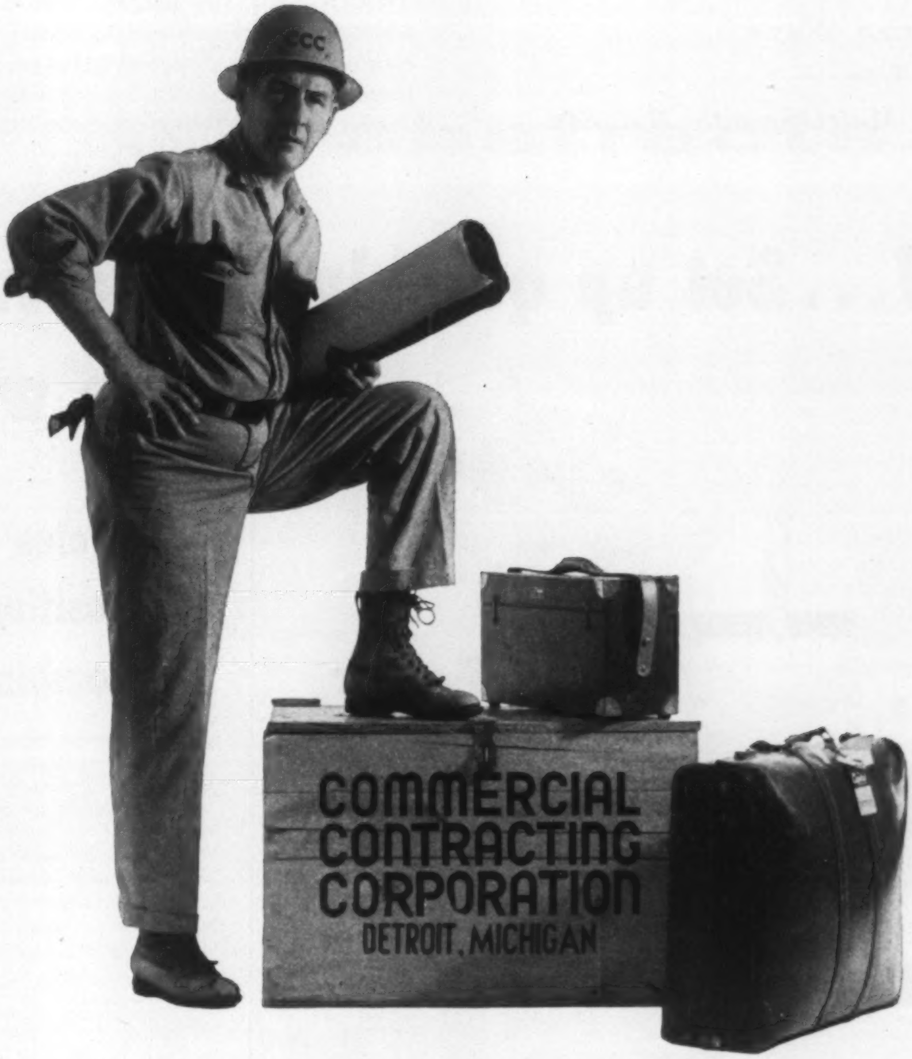
. . . Our engineering personnel have solved similar thermostatic charging problems. We would be happy to discuss this further with your reader . . .

James R. Barth
Barth Corp.

◆

. . . We have done automatic assembly operations for a number of refrigerator and heating companies and some of them have completely automatic devices for evacuation, purging and charging of either gas or liquid fill units. Inasmuch as production mentioned runs only 1500 units per day, we believe a simplified model could be designed and built . . .

Robert Moore
Moore Equipment Co.



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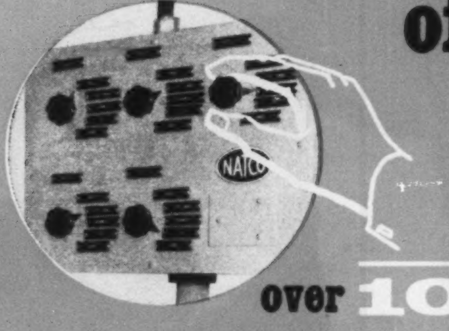
Natco Naturals

Cost-Cutting Ways
You Can Use
Standard Multi-Spindle Natcos

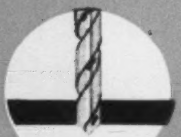
Any time your parts require machining *more than one hole*–drill, bore, face or tap–it may well be a "Natco Natural." Your standard Natco will produce substantial savings in a surprising number of situations, *even in small job-shop lots!* Call in your nearby Natco field engineer; he'll tell you in short order whether you've got a "Natco Natural" there.

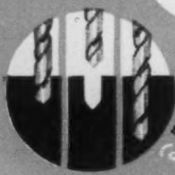
NOW...Set up quickly with a twist of the wrist

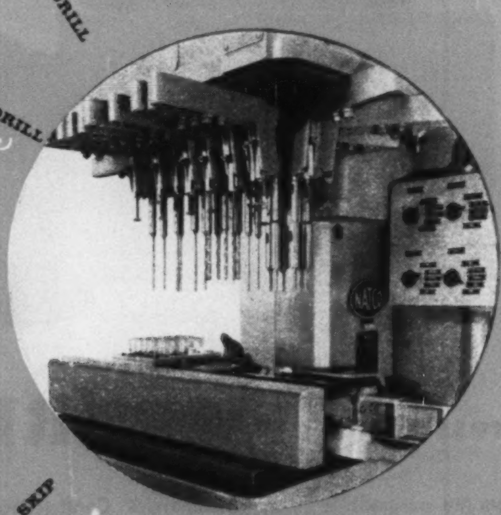


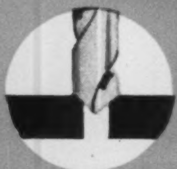
5 cycles
5 positions
over 100 combinations

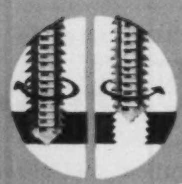
The five-position table mounted on a Natco H-6 adjustable spindle machine equipped with selector control panel makes it possible for the operator to pre-set over 100 machining combinations. Thus the capacity of the machine is greatly increased in number of holes, in complexity of hole patterns, and in variety of machining operations. Machine investment is kept at a minimum for the volume of work produced.

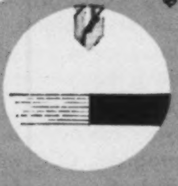








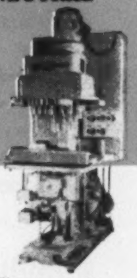




STRAIGHT-LINE
INDEX TABLE
COMBINED
WITH
PRE-SET
CYCLE
SELECTOR

Select either of

- **2** DEPTHS OF FEED *automatically*
- **2** FEED RATES *automatically*
- **2** MOTOR SPEEDS *automatically*
- **2** INDIVIDUAL SPINDLE SPEEDS PLUS NEUTRAL



Standard multi-spindle Natcos range from 1 hp, 10-spindle machines to 50 hp machines with up to 72 spindles. Spindles in standard Natcos are driven through universal joints and located by either adjustable arms of bored slip plates.

NATCO

National Automatic Tool Company, Inc.

Richmond, Indiana

Multi-spindle drilling, boring, facing & tapping machines. Special machines for automatic production.

Call Natco Offices in Chicago, Detroit, New York, Buffalo, Boston, Philadelphia, Cleveland, Los Angeles; distributors in other cities.

Circle 710 on Page 17

AUTOMATION abstracts

FUTURE OF AUTOMATION

By ROGER W. BOLZ
Editor

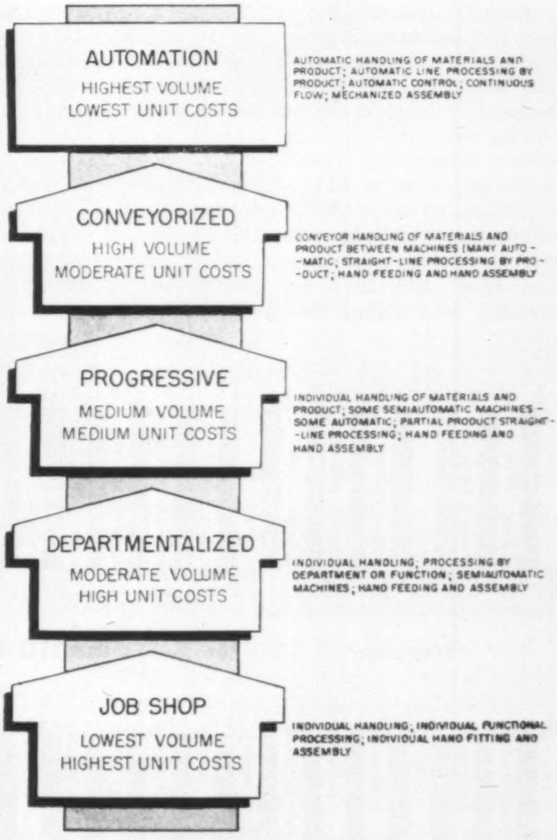
MOST discussions of automation to date have been concerned with its impact on the economy. In a way, to speak of automation's impact brings to mind a collision— a dynamic reaction to a tremendous force. Perhaps this term is a bit too emphatic—perhaps even misleading. In fact, if we look only at the 1956 advance in productivity level, we might conclude it has little.

Neverthless, automation will continue to have a gathering influence and effect. Its influence, however, will be evolutionary—a slow and gradually spreading effect of tremendous benefit. Because it depends greatly upon engineering, research, development and plain ingenuity, fostered by economic pressures, its advance will be geared to a large extent to business economics.

It seems to me that in presenting this subject the assumption is always made that automation is a known technology relentlessly infiltrating the industry. There is evidence to question this point. Today, the big problem appears to be otherwise. Without a positive approach and careful study of the possibilities, the benefits of automation may never be realized in many cases, or not realized in time to be of help. Few business managements are prone to change or invest money without good reason. Basically, automation is stimulated by economics.

Advance into successful automation must always have as its goal a positive aim and purpose. From a business standpoint certain important factors as a rule force a move toward, into, or to greater automation. Among the many, a few significant factors are: (1) loss of market due to overpricing; (2) limited market due to cost of product; (3) failure of product due to low quality; (4) high service costs due to low quality; (5) need for rigid purity or sanitary conditions; (6) product quantity demand beyond manual capacity to produce; (7) strong competitive conditions; (8) delicate, violent or unsafe materials handled; (9) lack of adequate labor; (10) job or production conditions unsuitable for human endurance; (11) available workmen refuse to labor under prevailing job conditions; (12) desire to bring badly needed goods within the reach of all pocketbooks.

These and many equally important fundamentals, among which may be the strong urge to remain in business, can and should spur the businessman toward seeking automation as an economic solution to his problem. However, he will not necessarily obtain success, as everyone seems to take for granted. More often he may fail without considerable help because the technical and business aspects are complicated—more so than any in the past. It seems to me we should be working to learn how to apply these principles and fundamentals to better advantage in a positive way rather than using the negative approach of trying to make tremendous conclusions as to the social effects of a development which is little understood by the layman but which has resulted from


AUTOMATION
HIGHEST VOLUME
LOWEST UNIT COSTS
AUTOMATIC HANDLING OF MATERIALS AND PRODUCT; AUTOMATIC LINE PROCESSING BY PRODUCT; AUTOMATIC CONTROL; CONTINUOUS FLOW; MECHANIZED ASSEMBLY
CONVEYORIZED
HIGH VOLUME
MODERATE UNIT COSTS
CONVEYOR HANDLING OF MATERIALS AND PRODUCT BETWEEN MACHINES (MANY AUTO--MATIC; STRAIGHT-LINE PROCESSING BY PRO--DUCT; HAND FEEDING AND HAND ASSEMBLY
PROGRESSIVE
MEDIUM VOLUME
MEDIUM UNIT COSTS
INDIVIDUAL HANDLING OF MATERIALS AND PRODUCT; SOME SEMIAUTOMATIC MACHINES - SOME AUTOMATIC; PARTIAL PRODUCT STRAIGHT--LINE PROCESSING; HAND FEEDING AND HAND ASSEMBLY
DEPARTMENTALIZED
MODERATE VOLUME
HIGH UNIT COSTS
INDIVIDUAL HANDLING; PROCESSING BY DEPARTMENT OR FUNCTION; SEMIAUTOMATIC MACHINES; HAND FEEDING AND ASSEMBLY
JOB SHOP
LOWEST VOLUME
HIGHEST UNIT COSTS
INDIVIDUAL HANDLING; INDIVIDUAL FUNCTIONAL PROCESSING; INDIVIDUAL HAND FITTING AND ASSEMBLY

EVOLUTIONARY PHASES OF PRODUCTION

Fig. 1—Chart illustrates steps in evolution of manufacturing operations from job shop to automation level.

his own demand for a higher social order.

One development breeds another. Each upward step in our social order and standard of living must be made from the one below. Automatic flour milling became a necessity to bring sacked flour to the population at an acceptable cost barely over growers cost. In the USA the industry has probably been as automatic as it will get for some 30 to 40 years already. No one would dispute the need or necessity. The same is true of volumes of items we consider a vital part of our everyday life—such items include things like cigarettes, toothpicks, candy, pop, matches, food products, and on and on.

Today's effort continues the long, ardous path to successful manufacture of more and more products and items at lowest unit costs, highest quality and necessary quantity while creating jobs, both direct and indirect, with greater and greater pay and skills along with continued return to investors and stockholders.

A great need exists to promote factual and specific understanding of this important industrial technology as we move into a new age. The question is not so much how can we cope with the social effects of automation as it is how can we use automation to advance our position and insure a better future. Where there is no vision or enterprise there is no accomplishment.

Alfred North Whitehead, the great scholar, has perhaps summarized most poignantly the conditions under which advances such as automation can flower and bear fruit. In his book, "Adventures of Ideas" he says: "Every epoch has its character determined by the way its populations react to the material events which they encounter. . . They may rise to the greatness of an opportunity, seizing its drama, perfecting its art, exploiting its adventure, mastering intellectually and physically the network of relations that constitutes the very being of the epoch. On the other hand, they may collapse before the perplexities confronting them. How they act depends partly on their courage, partly on their intellectual grasp."

Definitions and Origins

We have been distressed greatly by the widespread concern over a precise definition for the word "automation." Volumes have been recorded but unfortunately the interest has been largely academic without real desire for understanding the field of activity for which the word was coined and for which it is broadly used today. Concentration on definition has caused many to lose sight of reality.

Seeking a definition for the word recently, one company recorded over 40 separate and different definitions! The complaint is made that it is a bad word because it has no precise definition accepted by all.

Our approach to this problem accepts the fact that few words have precise definitions. The dictionary always shows alternatives and varied interpretations for words normally thought to be precise. Definitions for the word "automation" today vary with the experience and background of the definer, reminding us of the well-known fable of "The Blind Men and the Elephant."

Based on the understanding and usage of the term throughout industry, our overall general definition would be something like this: "Automation encompasses the basic technology of manufacturing, processing, or performing services automatically to the extent or degree dictated by business economics, market demands, and product characteristics."

For industry it is simply continuous and automatic manufacturing ranging anywhere from a few operations all the way to the whole plant—from the office to the warehouse. The important part is that as many as possible of a series of production operations needed to produce a product be integrated into a continuous line, *Fig.* 1. The specific varieties of techniques needed to achieve this aim, with competitive

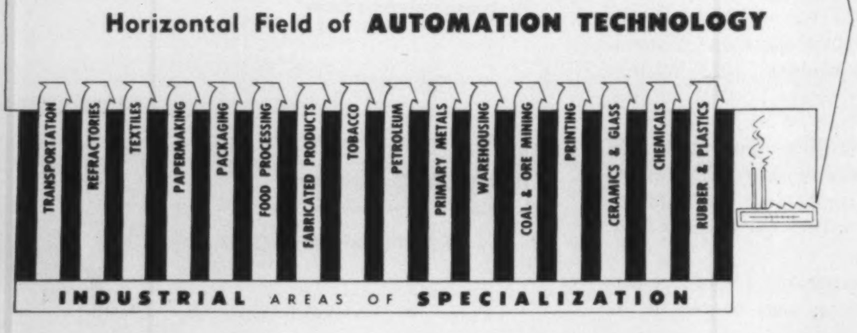

FUNCTIONAL AREAS OF SPECIALIZATION
ELECTRONIC CONTROL
MACHINES & PROCESSES
TOOLING
ELECTRICAL CONTROL
MECHANICAL HANDLING
MEASURING & GAGING
INSTRUMENTATION
HYDRAULIC CONTROL
MECHANICAL CONTROL
MECHANIZED ASSEMBLY
PNEUMATIC CONTROL
CONVEYING & DISPENSING
DATA HANDLING
SENSING & WEIGHING
POWER
FEEDING & SORTING
Horizontal Field of AUTOMATION TECHNOLOGY
TRANSPORTATION
REFRACTORIES
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Fig. 2—Automation requires horizontal co-ordination of many vertically specialized engineering fields such as machine design, instrumentation, hydraulics, etc. It likewise cuts across many areas of industrial experience and knowhow. For example, papermaking, packaging, metalworking, and warehousing operations may be involved in a complete system.

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advantage, are not of key importance. The practical production results, however, are.

We can trace the origin of the word "automation" itself back at least 10 years to its first regular use at Ford by Del Harder, executive vice president. Within the few years of usage it has grown to assume the full meaning of continuous automatic production throughout all industries. But, more interesting yet is the fact that we can trace the origin of this idea of continuous manufacture to Britain early in this century. Recorded in a paper, presented before the Institution of Automobile Engineers in February 1925, Mr. Frank G. Woollard outlined his working theory of continuous production embracing the major factors now sought by industry through "automation" efforts.

Thus today automation engineering has evolved piecemeal out of many industries to fulfill a basic principle of manufacture conceived years ago. Fundamentally, the principles of continuous production had been tried with varying success much earlier without benefit of a formal name.

To recognize the development today as part of this evolution is an engineering necessity—there is no value in definitions except pride of authorship. The only thing that makes the principle of continuous automatic production significant is its value in terms of economics and people (both as workers and consumers). The important job, therefore, is to learn the fundamentals of automation, to learn how to direct and use its powers wisely.

Technology

In the development of automatic operations, three key phases are involved. These can be reduced to: (1) the processing steps or equipment, (2) the handling system or devices, and (3) the automatic control arrangement. Suitable results are obtainable only through careful integration of all three phases.

Once it is recognized that automation is basically a new approach and not a precise state, condition or device, then, several important conclusions can be drawn: (1) automation is a horizontal engineering technology; (2) it requires horizontal integration industrially; (3) it creates a broad new job function.

Automation requires the co-ordination of many specialized vertical engineering fields, *Fig.* 2. Such areas of knowledge as process design, production equipment, handling devices, instrumentation, measurement and sensing, hydraulics, pneumatics, mechanisms, etc., must be drawn upon to attain satisfactory engineering results. This constitutes a difficult and complex problem for men ordinarily accustomed to working in one field only.

Secondly, automation creates a horizontal technology from an industrial standpoint. Complete automatic systems may require the integration of many specialized areas of industrial experience and knowhow. Chemical, food, packaging, paper, metalworking, primary metal, petroleum or warehousing operations may be brought into complete systems in any and all combinations. Few companies have developed engineering departments with experience in all fields to make successful automation sure.

Thirdly, automation has brought about the development of a new engineering job function. Today we find automation engineering throughout all industries. Documenting this new requirement in the engineering area is a statement in the new catalog of the Automation Div. of Patterson-Emerson-Comstock Inc., Pittsburgh. I quote:

"The Automation Engineer: Examination of the growth of most mechanized plants will show that the present state of development was reached through sporadic improvement in one or more facilities at a time, to meet the needs and conditions of production as they arose. This will have led to a pattern of thinking on the part of those in authority—including the plant's own engineers—that is directly opposed to the thinking necessary for the successful conversion to automated production. Actually, an entirely new perspective—a new philosophy of production—is called for. Where, in the past, a plant's facilities were departmentalized, now, with the prospect of automation, each facility must lose much of its individuality and develop a closer relationship to the system as a whole. All functions must become *one* function. Integration must become complete.

"This need for a new perspective has stimulated the formation of groups known as automation engineers. Such groups should have sufficient combined range of productive experience to thoroughly analyze the present plant operation in the light of future automated production. Qualifications should include the ability to design, procure and install new mechanical and electrical equipment to be integrated with existing facilities where possible."

Basically, automation engineering is a new high-level approach to manufacturing and services engineering. It demands creative "before-the-fact" engineering of facilities for productivity and as such there is a growing need for educational facilities to train engineers in the fundamental aspects of automation engineering.

Problems in Accomplishment

Thus you can see, there are many factors that militate against easy achievement in automation. I would like to emphasize but a few that appear to be important. One is the need for improved management techniques. Because effective management of automated facilities calls for factual up-to-the-minute statistical data for long range planning, more specific and timely information is needed today. An important part of this data is the kind that can be gathered only by such groups as the Commerce Department and the Census Bureau. Most of these data today are really past history and of little use in planning for tomorrow's operations.

Development of up-to-date methods for obtaining pertinent and necessary business statistics, facts on automation developments, and basic knowledge of business activities beyond hearsay would aid tremendously in tomorrow's planning. It would also create increased business confidence and confidence in America's future.

One of the greatest deterrents to effective employment of automation is the almost complete lack

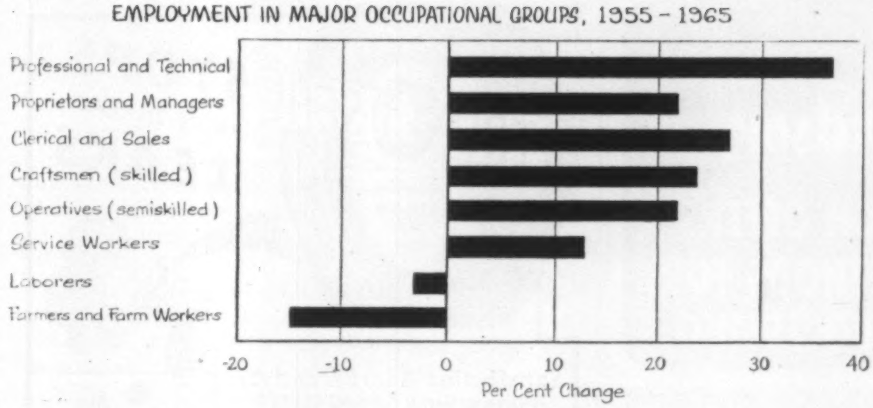

Fig. 3—Chart illustrates anticipated change in occupational structure of labor force by 1965. Professional and technical groups show largest increase. Unskilled laborer needs will decline. Source, U.S. Dept. of Labor.

of knowledge in the area of forecasting costs. AUTOMATION has cosponsored two Conferences on Manufacturing Automation with Purdue University, to date. It has been revealed at these Conferences that there is a great area of disagreement and a need for basic facts on costs. There often appears to be no effective means for determining equipment costs or production profitability beforehand in order to plan properly. To enter into an automation program without some close approximation of costs can be disastrous and result in loss of the business.

Because there is no really good way to forecast accurately the cost of special automatic lines, many small equipment builders have gone into bankruptcy under a fixed price policy. Without hard facts on costs, the buyer of such equipment cannot justify the purchase on the basis of its effect on his operating costs. Surely there is need for assistance in this area and we are endeavoring to develop sufficient information to assist both buyer and builder of automation equipment.

Tied in closely with the production and management problems are those of product distribution. It has been emphasized many times that production is not the whole problem—distribution is also important. There is no value in solving the automatic production problem unless we also solve the distribution problem. The better standard of living made

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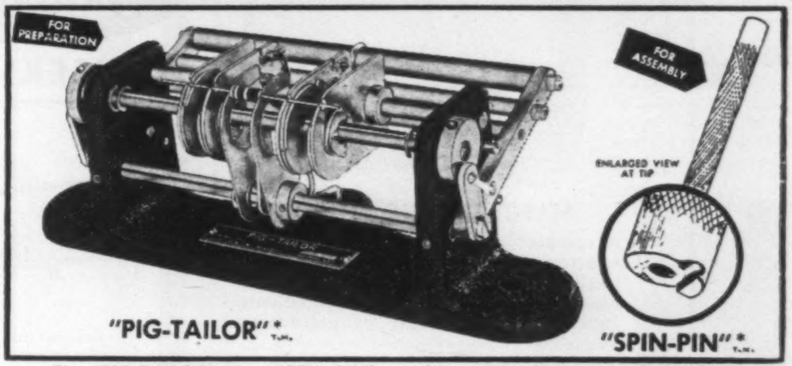

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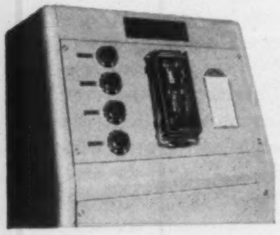

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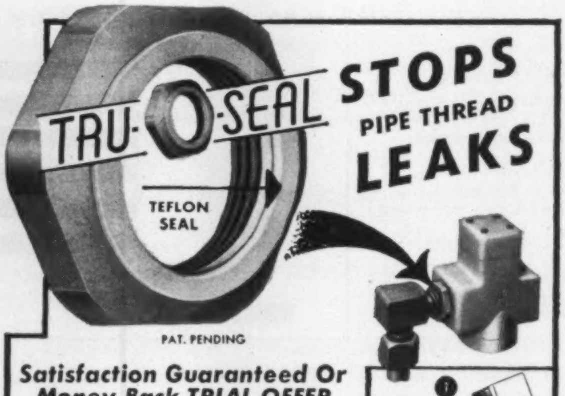

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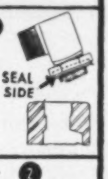

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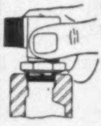

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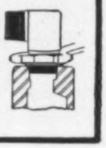

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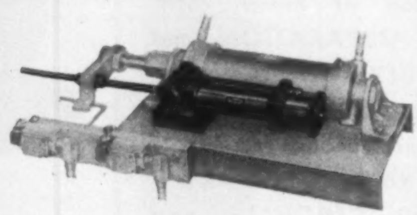

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possible through automation of production operations can be realized only through more effective means of product distribution. Many excellent worthwhile products never do reach the consumer owing to our cumbersome outmoded distribution channels. This is especially a problem for the small businessman.

Another area of concern is that of product design where engineered products are manufactured. The design engineer strives to design, and the production or manufacturing engineer to produce, products that will perform their function economically and well. But it is imperative to realize that design and production are intimately related. Just as in warfare, where offense and defense stimulate each other, design and production can prod one another ahead.

Some new product designs force the manufacturing engineer to develop or invent new methods of manufacture and every advance in the art of manufacture must be exploited for lower costs. There is no plateau of full attainment. Every day brings new and fuller knowledge. Mutual understanding and exchange of knowledge between the two groups can be highly beneficial generally, but in the field of automation, success and fundamental economics dictate equal recognition of these two functions with manufacturing engineering for automation commanding the key position in many instances. Colleges and universities as yet offer little or no formal education in the broad principles of manufacturing engineering and design for production. There is great need for educators' recognition of these important areas of engineering.

For worthwhile results today the basic functions of product design and manufacturing engineering must be directly co-ordinated to effect a realistic move into either partially or fully automated production. Two factors are present: (1) a design for

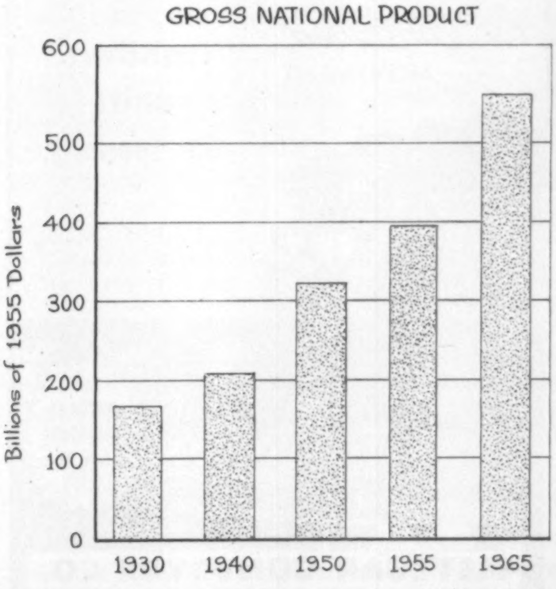

Fig. 4—Constantly growing need for goods and services to keep pace with rising population and provide increased living standards will require estimated GNP of $560 billion in 1965. Source, U. S. Dept. of Labor

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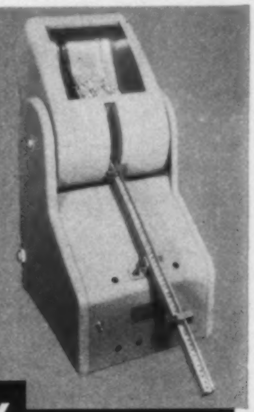

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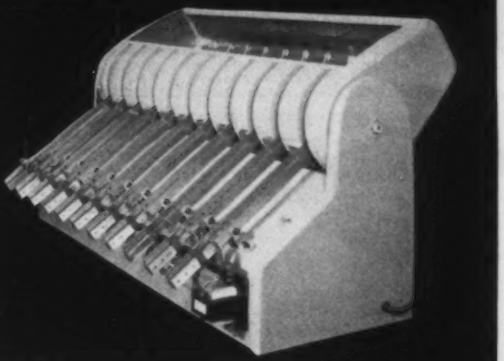

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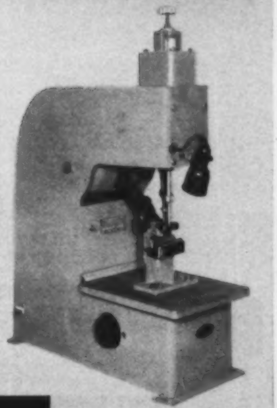

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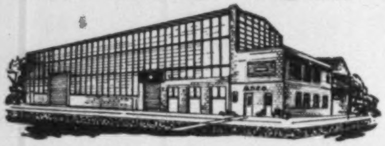

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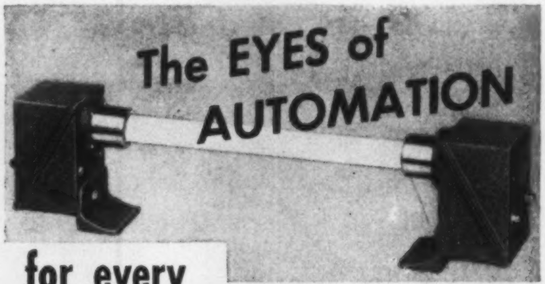

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conventional manufacture may make automation and lowest manufacturing cost impossible, or (2) a minor design change of little market significance may obsolete an effective installation of automated equipment.

Economics possible with effective automation cannot always be achieved merely through simple purchase of machinery or controls. Complex combinations of equipment and devices, owing to particular product features, may be necessary to attain the most desirable production line integration. However, products carefully engineered for automatic production, regardless of the level of automation attained, will always result in lower cost in production. Products so designed can be produced on a gradually increasing level of automation to suit customer demand and acceptable pricing.

There is need for careful consideration of the growing importance of manufacturing engineering. Know-how in manufacturing engineering offers the smaller producer the most effective weapon to keep his position in the competitive race of free enterprise.

Effects of Automation

What effects, if any, can be traced to automation and its gradual development in the past? What of the future? I say effects are good on both counts!

There has been altogether too much emphasis placed on the social and business impact of automation. In an evolutionary force there is no impact—only slow change. Development of automation can only occur as fast as man can dream and devise the processes, machinery and controls needed. And, as most businessmen must be conservative, investment in upgraded plant equipment occurs only under the continued pressure of economics, competition and market demand. In addition, equipment replacement policies based on depreciation allowances under present tax laws create a severe barrier to fast equipment replacement. A new flexible policy of fast writeoff is needed.

There is a growing need with automation to consider entire production lines, or plants, as expendable tooling, useful only for the short duration of effective product sales life. Automation equipment, unlike machinery in past years, is often of no value for producing economically products other than those for which it was designed.

That more intensive study and application of automation techniques is needed is plainly underscored by a recent statement by General Electric accompanying a rise in lamp prices: "Although General Electric's lamp plants have long been recognized as leaders in mechanization, it is virtually impossible to develop, build, and install new types of machinery fast enough to effect manufacturing economies which would offset increasing costs of labor and materials."

Nevertheless, while compensation of industrial employees rose some 60 billion, or 60 per cent, between 1948 and 1956, with corporate net profits taking little or no increase, prices of manufactured goods rose only 13 per cent. This is a notable record but it can be bettered.

Automation does not grow of itself. Meticulous

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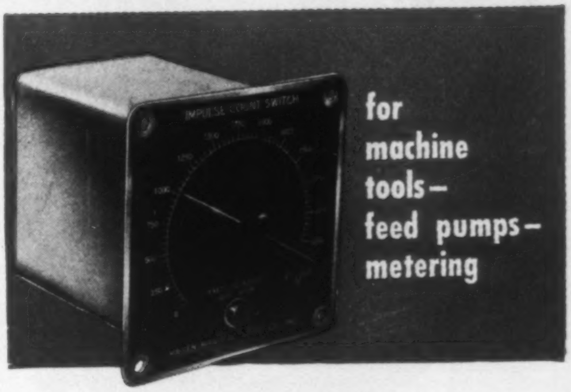

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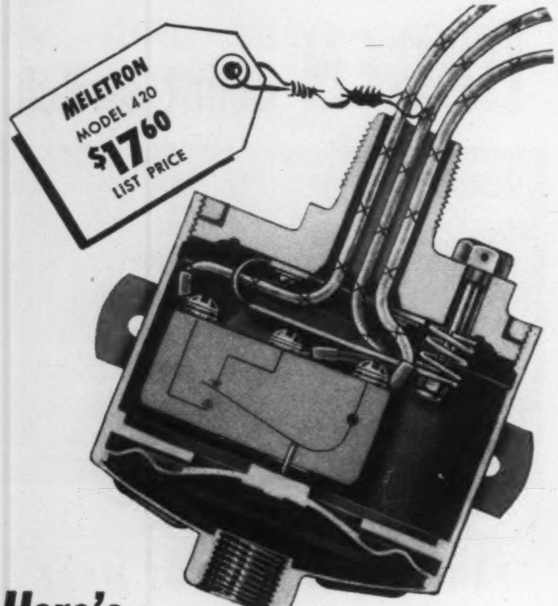

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are and feeding is necessary. We cannot expect to reap a harvest unless the seed is sown. Industry has a responsibility to understand and employ automation to the fullest practical extent if we are to realize our aims of increased living standards and job levels in the years to come.

It is worthwhile to note that in manufacturing alone, some 2.5 million people per year must be hired merely to replace voluntary "quits." Of the 75 million persons employed in 1955, 11.5 million changed jobs during the year. The most generous estimates of *possible* job displacement per year through automated installations, based on investment of 20 billions in equipment, have been placed between 300,000 and 600,000. Obviously, this problem of overall job displacement is of insignificant proportion. Actually, major job losses in industry during the past decade can largely be traced to other causes, one of which is failure to automate.

Another important aspect concerns the rising level of education today. As a result of a careful study, professors Baldwin and Shultz of MIT came to this conclusion: "We are entitled to a cautious hope that automation may afford a partial answer to those who look at the rising education levels in this country and ask, 'What are people going to do with all that education when they find themselves on the dull and routine jobs of American industry?' Mechanization may indeed have created many dull and routine jobs —automation is not an extension but a reversal of this trend: it promises to cut out just that kind of job and to create others of higher skill."

Automation creates a greatly increased demand for engineers, scientists and other skilled personnel. In *Fig.* 3 are shown the projected trends by job categories. A look at the facts bears this out. Statistics of the chemical industry, for instance, show a percentage increase in professional and management jobs greater than the rise in output in the past 10 years. Production workers, however, remained virtually stable during the same period. The steel industry shows the same characteristic.

Probably most potent in the way of statistics are those concerning population. Automation can be most effective in serving an expanding market. By 1975, the latest Department of Labor figures forecast a population increase of 55 million and a Gross National Product doubled to $858 billion. A 100 per cent increase in output will be demanded from a total labor force roughly 28 per cent over today's level. Gross National Product predicted for 1965 is shown in *Fig.* 4.

To serve the needs of this growing and vastly expanding country, automation has a job to do. We are committed to a rising standard of living and a program of world leadership. Business management must understand the potentials of automation and strive to bring it to full fruition. The time is past for random academic dissertation. We must begin to actively build for the fascinating and challenging future.

From a talk entitled, "Automation—the Growing Need" presented at the Subcommittee on Economic Stabilization Hearings on Automation and Recent Trends, Washington, D. C., Nov. 1957.

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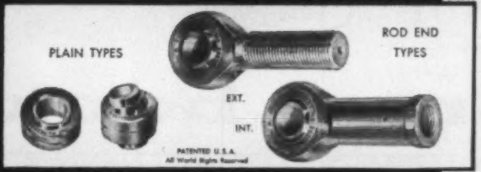

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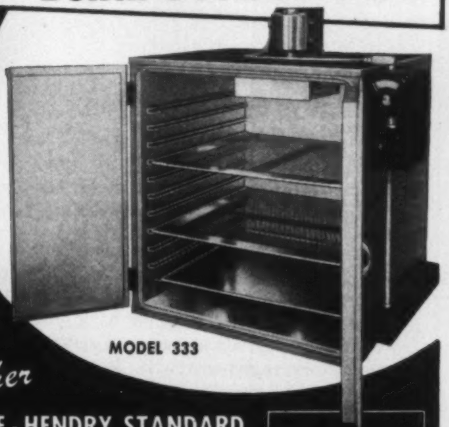

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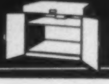

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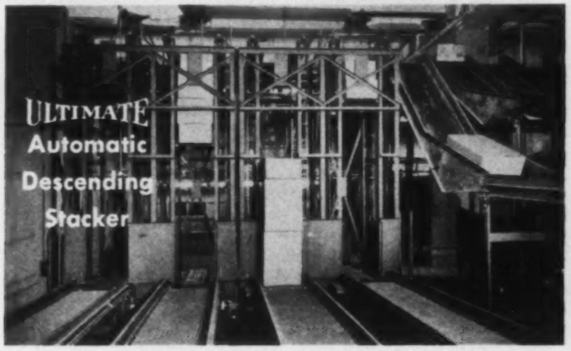

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Paperbound, 32 pages, 8½ by 11 inches, illustrated; available from Educational Services Dept., Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.; $2.00.

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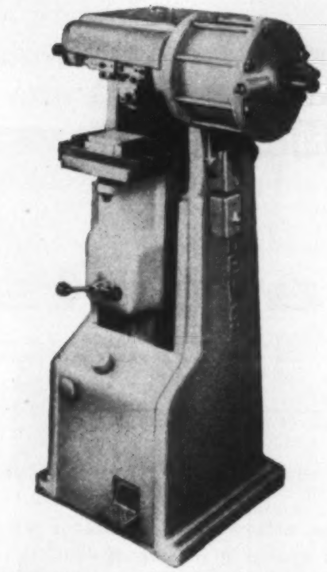

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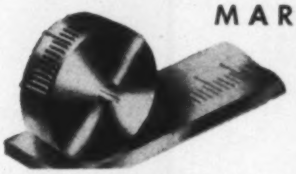

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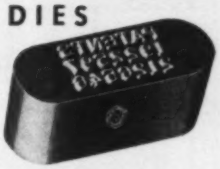

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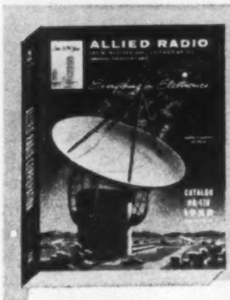

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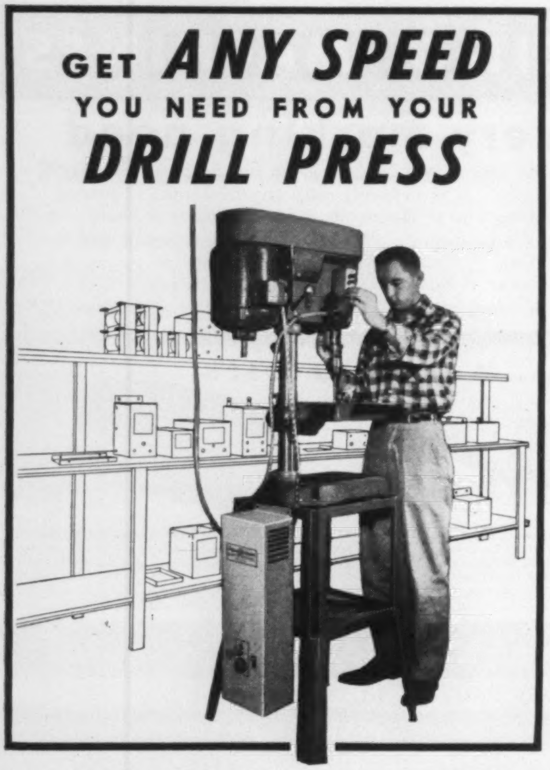

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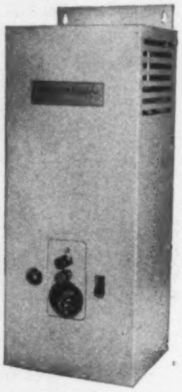

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Conveyor moves arbors to an apparatus which rotates them and applies a coating of sand to the exterior surface of each arbor. Knife device automatically forms the sand coating to a predetermined shape. Patent 2,800,689 by William G. Reichert.

ORIENTATING MECHANISM

Elongated articles of irregular cross section are fed from a distributor into a horizontal rotating cylindrical drum open at both ends. Articles move toward either end of drum into receiving containers. Direction of movement is determined by orientation of largest cross section with respect to smallest. Patent 2,800,993 by Paul Baskin, assigned to Sylvania Electric Products Inc.

VACUUM EXTRACTOR APPARATUS FOR REMOVING HOLLOW FLEXIBLE MOLDED ARTICLES FROM REENTRANT MOLD CAVITIES

Mechanical finger is inserted into a small opening of a flexible hollow article inside a reentrant mold cavity. Threaded enlargement on finger seals article, and suction applied through finger collapses article for withdrawal from mold. Patent 2,804,643 by Theodore A. Miller and Theodore A. Miller Jr.

HIGH SPEED FEEDING MECHANISM FOR FOLDING BOX MACHINES

Suction gripper of a feeding mechanism removes single blanks from a stack and deposits the blanks in a different position and plane on a folding die. Patent 2,805,060 by Frank M. Lefief, assigned to Baljak Corp.

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Apparatus applies a flat thermoplastic strip on edge about a longitudinally advancing wire as an open-turn helical fin. Patent 2,805,179 by Harvey Burr, assigned to British Insulated Callender's Cables Ltd., London, England.

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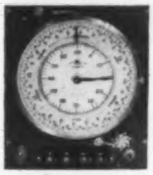
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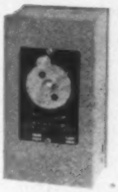
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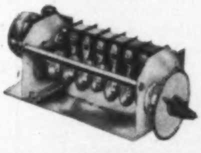
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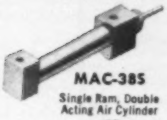
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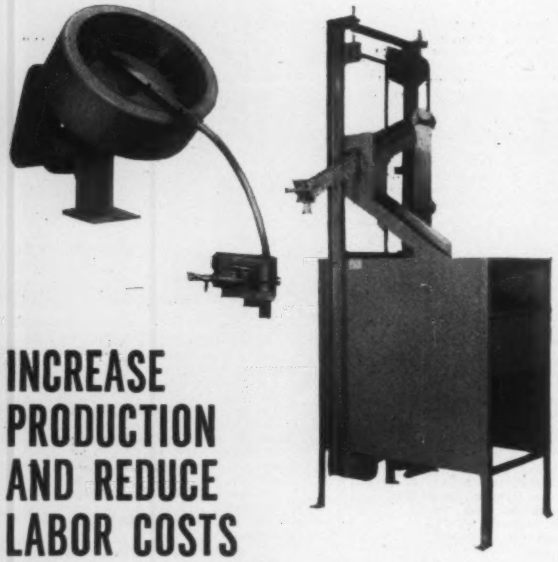

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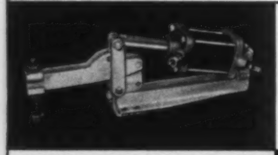

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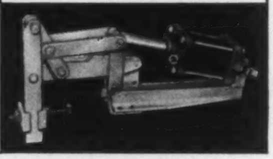

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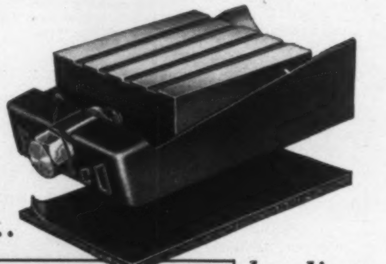

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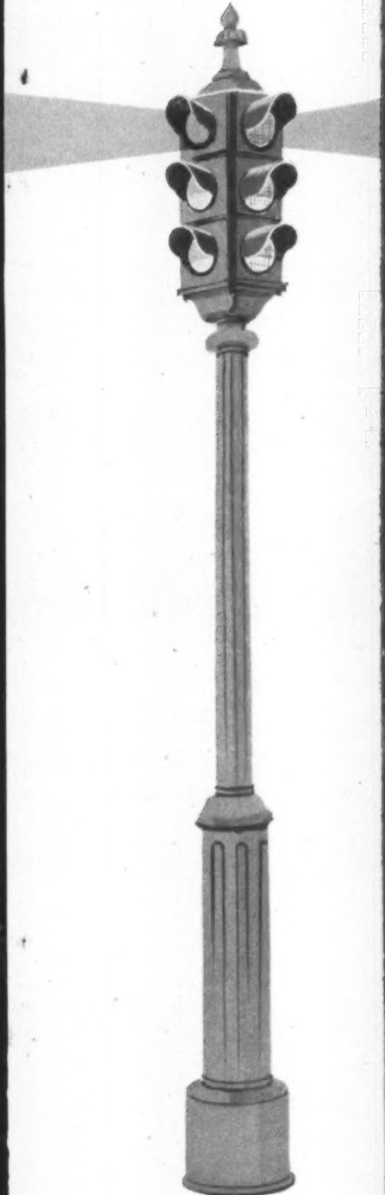

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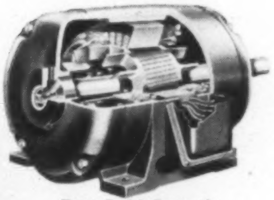
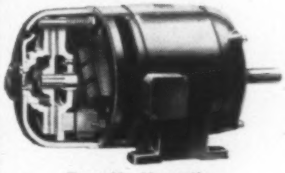


Type D, AC Dynamic

ROLLING STOP...Master Type D Dynamic Unibrake Motors. Braking is obtained with a unique, patented brake winding superimposed on the stator winding. Simple, compact, with no DC current required, the brake has no moving parts. There is nothing to wear or adjust... braking torque repeats consistently. Particularly recommended for automatic applications where static holding is not desired. Sizes ¼ to 30 H.P.

MASTER UNIBRAKE MOTORS



Type M—Magnetic

STOP-HOLD...Master Type M Magnetic Unibrake Motors. For quick, controlled stopping... especially when you want to hold the load. Spring-setting magnetic brakes of the friction disc type combine with motor in a compact, integral unit. Sizes... ⅛ to 150 H.P.

MASTER GEARMOTORS and variable speed drives can be furnished with Unibrakes, too. See Master for the perfect power drive for you.

THE MASTER ELECTRIC CO.

DAYTON 1, OHIO

DIVISION OF RELIANCE ELECTRIC AND ENGINEERING CO.

Circle 652 on Page 17

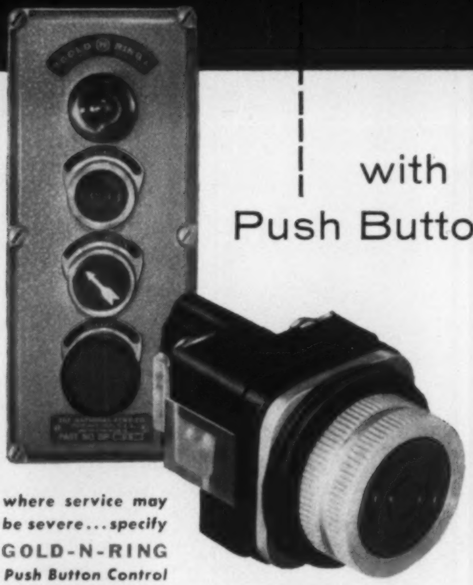
1,500,000 CYCLE

SUBMARINE TEST

Proves

1. **NO SEEPAGE** from water, oil or coolants
2. **LONGER LIFE** for electrical contacts

GOLD N RING
LOAD
SPINDLE START



with THE NAMCO SEALTIGHT **GOLD N RING** Push Button Control Station Switch

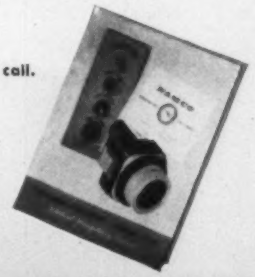
This test simulated conditions much more severe than even the most demanding electrical control service would ever duplicate. Without once "coming up for air," this standard GOLD-N-RING 2-unit control switch was immersed in fluid for more than 338 hours, during which momentary electrical contact was made 1,500,000 times—at the rate of 64 cycles per minute.

This test proved the flexing qualities of the synthetic, oil-resistant diaphragm beyond a doubt. It also pointed up the "staying qualities" of the extra-large, heavy-duty, alloy silver electrical contacts.

If you are looking for a switch that is designed and built to *keep on performing* long after your machine is installed, you'll find we talk your language.

where service may be severe . . . specify
GOLD-N-RING
Push Button Control Station Switches . . . and be sure

Ask us to send Catalog ECS-56—or, better yet, ask a representative to call.



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